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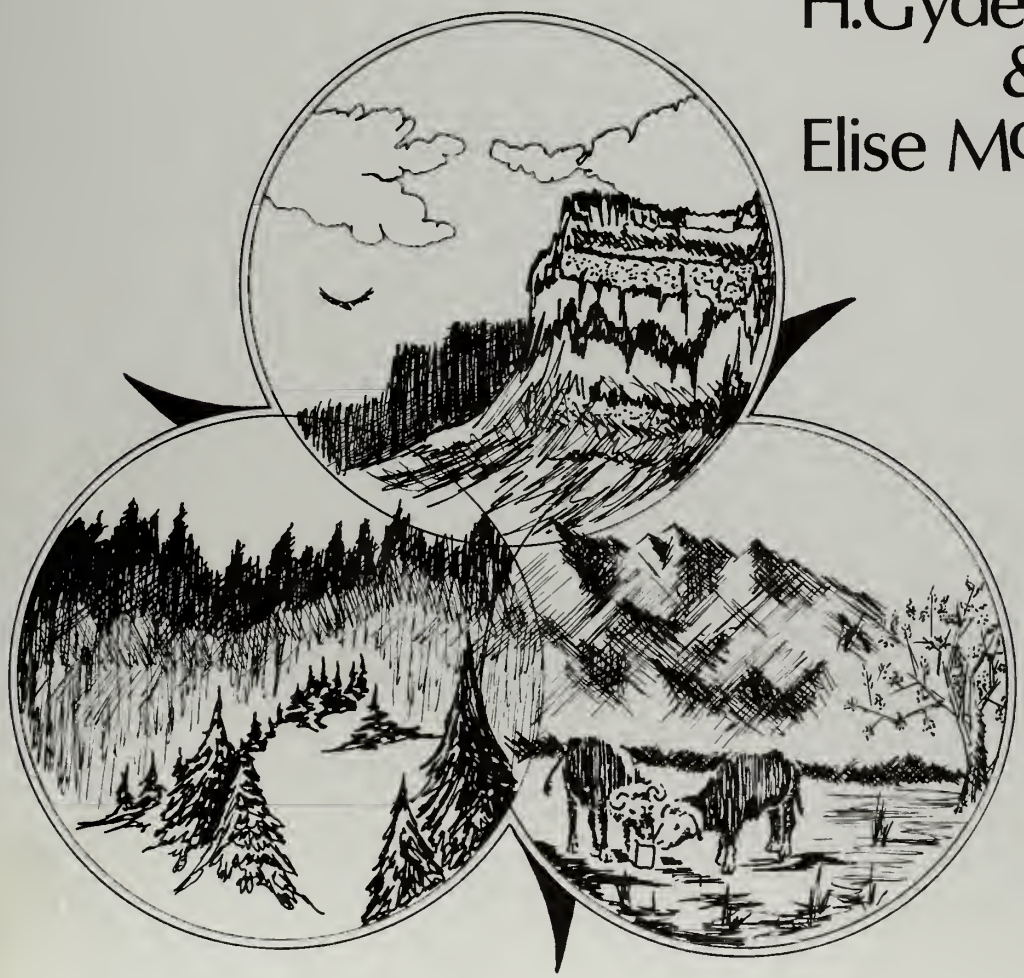
U.S. DEPARTMENT OF THE INTERIOR – BUREAU OF LAND MANAGEMENT

INTEGRATING INVENTORIES

An Annotated Bibliography

By

H.Gyde Lund
&
Elise Mc Nutt



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by

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and

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Subject Index

The alpha character represents the letter of the alphabet under which the publication is listed. The number indicates the sequence the publication is listed under that letter.

INTEGRATING INVENTORIES

An Annotated Bibliography

by
H. Gyde Lund
and
Elise McNutt

Integrated inventories are becoming commonplace. The Bureau of Land Management, for example, has been developing multiple resource inventories over the last two or three years.

The purpose of this bibliography is to provide a comprehensive listing of publications from the biological sciences fields dealing with multi-resource, multiple use, multi-produce and multi-variant inventory techniques as they relate to natural resource management. Some related publications from the business field are also included. In addition, some standard background publications on inventory and land use planning are given.

This bibliography generally covers the period from 1970 thru 1978, although some earlier and later documents are listed. Over 530 citations are provided.

The abstracts generally come directly from the source documents or from Dissertation Abstracts in the case of the thesises. Listings containing no annotations were not available to the authors at the time of compilation.

The publications are listed alphabetically by the author's last name. The citations are also numbered and keyed to a subject index. Subject groupings include Policy, Philosophies, Land Use Planning, Information Requirements, Land and Vegetation Classification Systems, Remote Sensing, Mapping Systems, Automated Mapping Systems, Statistical Aspects, Design Processing Systems, Information Systems, Resource Allocation and Modeling, Regional Analysis and Case Studies, and Reference Material including Proceedings, Bibliographies and Dictionaries.

01 ABICHANDANI, C. T., and A. Kumarsen.
1977, MLRU Mapping - A Concept of Composite Mapping Unit for Integrated Land Survey. Annals of Arid Zone. 16(2): 263-270.

Working out of a composite mapping unit for integrated regional survey, with the aim of providing a basis for the assessment of the resource potentials of an area deserves special cartographic attention. The hitherto available mapping techniques do not fully serve the purpose under Indian arid zone conditions. A new composite mapping unit - Major Land Resources Unit (MLRU) - has been involved based on the principle of classification of lands having recurring patterns of biotic and abiotic environments.

The cartographic techniques and advantages of the MLRU system have been described.

02 ADAMS, Norman S.
1978. Integrated Multi-resource "In-Place" Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55.; Rocky Mt. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO, pp 454-462.

A multiple-resource inventory was designed, conducted, and utilized in the development of land classification for timber management planning on the Siuslaw National Forest. Inventoried resources include soils, water, wildlife and fisheries, visual, and timber. Transportation systems and recreation facilities data were reevaluated with the above for integrating into a unique process of resource value analysis and decision-making. Results have been utilized additionally for preparation of Environmental Impact Statements and on-going Land Management Planning. Experience to date provides excellent illustration of improved efficiency and thoroughness derived from an interdisciplinary approach to planning and integration of inventory bases. Illustrated are: inventory designs and techniques; integration process for analysis/decisions; data base developments.

03 ADRIEN, Pierre Marie, and Baumgardner, Marion F.
1977, Landsat, Computers, and Development Projects (Sudan example): Science, 198 (4316): 466-470.

The science of remote sensing, that is, the collection of physical information about the earth's surface from some distance away, such as from an aircraft or a satellite equipped with remote sensors, is of great importance for economic development.

At present, each of two U.S. satellites, Landsat 1 and Landsat 2, orbits the earth once every 103 minutes, scanning the same area on the earth's surface once every 18 days. The orbiting schedules are such that images of approximately 920 kilometers over the same scenes at 6- and 12-day intervals. The satellites transmit the scanner data to receiving stations in Brazil, Canada, Italy, and the United States.

This data acquisition system can provide information at frequent intervals about the location, availability, and changing conditions of the natural resources of specific project areas. Such information is essential for establishing appropriate priorities and effective management plans in developed and developing countries. In considering the mapping and monitoring of earth resources, on national, regional, and global bases, perhaps no better approach has yet been devised by man than the computer-implemented analysis of multispectral scanner (MSS) data acquired by earth-orbiting satellites.

04 AIRD, Paul L., ed.
1975. Canadian Forest Inventory Methods. In Proceedings of a Workshop. Toronto: University Press. 283 p.

A collection of papers from a workshop, emphasizing the practical application of current methods of forest inventory.

05 ALDRICH, Robert C.
1977. Inventory of Forest Resources (Including Water) by Multi-Level Sampling. U.S.D.A., F.S., Rocky Mtn. Forest and Range Exp. Stn.

Four independent LANDSAT based forest and water resource inventory Studies were conducted in nine northern Virginia coastal plain counties. The studies include: (1) a water resource inventory by conventional photo interpretation, (2) a forest inventory by conventional photo interpretation, (3) a forest area inventory by computer assisted techniques, and (4) a study of solar and atmospheric effects on LANDSAT data. In addition, an example is given for using LANDSAT and other information sources in an area decision management plan.

06 ALDRICH, Ribert C.
1978. A National Multi-Resource Inventory System; Possibilities, Problems, and Progress. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. pp. 474-480.

In response to RPA-1974, the Forest Service has taken a leading role in developing inventory techniques with assistance from other renewable resource agencies. Alternative approaches, problems, and progress related to multi-resource inventory are presented and discussed.

07 ALDRICH, Robert C., Richard E. Francis, Gary E. Dixon, Robert W. Dana, and Edwin H. Roberts.
1977. Problem Analysis: Conceptualize the Framework for a Multi-resource Inventory System and Develop the Basis for an Operational Inventory for the Timber and Range Resource Components. Resources Evaluation Techniques Program, Rocky Mtn. Forest and Range Exp. Stn., Forest Service, U.S.D.A., Inservice Report. Xerox 83 p. and Appendices.

Looks at the need for multi-resource inventory through a review of pertinent Congressional Legislation. This background is a literature review for multi-resource applications, data requirements, and inventory design alternatives, sets the stage for the problem definition and a research and development approach to the problem solution.

08 ALFOLDI, T. T., and G. E. Beanlands.
1975. Towards an Operational Resource Inventory of Coastal Regions. Third Canadian Symposium on Remote Sensing, Edmondton, Alberta. 22-24 Sep. 323 p.

The government of Canada and the four Atlantic Provinces are considering undertaking a comprehensive 6-year inventory of coastal resources. The general objective will be to consolidate, in written and cartographical form, existing information and data on the biophysical and socio-economic resources as a basis for future decisions relating to the development, conservation and protection of coastal lands and waters. Many other countries and states with extensive coastlines have undertaken similar inventories to provide an information base for planning, management, educational and promotional purposes. Some of the more obvious needs for such a consolidated data base include:

(1) general resource base information for environmental impact assessments in coastal areas;

(2) a basis for comparing the resource implications of alternative industrial sites;

(3) a reference source for delineating and assessing ecologically critical coastal areas in need of protection;

(4) resource documents for the development of contingency protection plans in the event of major disasters such as marine oil spills;

(5) a basis for selecting coastal areas in which governments have particular interest in securing public access and use, such as for coastal parks, recreation complexes and docking facilities.

09 ALLEN, D. Neil.
1976. Polygonal Processing of Geographical Resource Information. Proceedings, Resource Data Management Symposium, August, Purdue University, West Lafayette, Indiana. 105-112 pp.

Computer techniques make it possible for the natural resource manager to record, store, manipulate and retrieve his data in "map like" form. This is done by representing the natural resource data in polygonal form. A closed plane figure bounded by straight lines or arcs of great circles more closely resembles the natural division of the resources than any other method. Polygonal processing of geographical resource data, therefore, gives the resource manager a "real world" situation in which he can work to get the information necessary for more effective management decisions.

10 ALVIS, Richard J.
1978. Time-Space and the Inventory of Ecosystems. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. pp. 299-302.

Natural resources are normally distributed as time-space progressions at a relatively constant ratio. Inventories designed accordingly establish a limited range in the time-space spectrum and various natural resources are viewed as entire time-space events from the focus. Those found to conform with the focus and have field observable features sufficient to make scientific inferences serve as classification criteria for ecosystems.

11 AMIDON, Elliot L.
1964. A Computer-oriented System for Assembling and Displaying Land Management Information. U.S. For. Serv. Res. Pap. PSW-17, 34 pp.

Maps contain information basic to land management planning. By transforming conventional map symbols into numbers which are punched into cards, the land manager can have a computer assemble and display information required for a specific job. He can let a computer select information from several maps, combine it with such nonmap data as treatment cost or benefit per acre, and prepare overlays and tabulations. The report describes specific and potential uses for the system and includes cost estimates.

12 AMIDON, Elliot L.
1978. Computer Mapping Systems for Integrated Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, Co. pp. 354-359.

Computer mapping systems can provide integrated, spatial resource information useful in wildland management. Methods to solve the major technical problem of data capture are shifting from manual to automatic. Mini-computers are expected to lower editing costs, but larger computers will still be necessary for complex analyses in the immediate future.

13 AMIDON, Elliot L., and E. Joyce Dye.
1976. Microcopying Wildland Maps for Distribution and Scanner Digitizing. U.S.D.A. For. Serv. Res. Rep. PSW-114, 12 pp.

Images in graphic or printed form can be reduced in size by microcopying. Microform is a collective term for stored microimages. Conventional microform films include silver halide, nonsilver diazo, vesicular and color. Criteria for selecting the proper format include map quandrangle size and reduction ratio. Among several competing types of microforms, only microfilm and microfiche were judged acceptable for application to wildland maps. Microimages can be digitized by automatic techniques. With careful planning, it is possible to digitize automatically forest map microimages for input to computerized mapping systems. Other benefits of microcopying include a reduction in the cost of handling and shipping the original documents, a savings in space, and making archival copies more lasting.

14 ANDERSON, James R.
1971. Land Use Classification Schemes Used in Selected Recent Geographic Applications of Remote Sensing. Photogramm. Eng., 37(4): 379-387.

The author is concerned primarily with the problem of developing land-use classification schemes which can be used with orbital imagery for making thematic maps of land use in the United States ranging generally in scale from 1:250,000 to 1:2,500,000. Briefly, some background on approaches to land-use classification based mainly upon aerial photographs that have been used in the United States gives a perspective to the review of the recent attempts to develop systems of land-use classification that would be useable with imagery from remote sensors placed in orbiting spacecraft.

To provide a framework for review and evaluation of some attempts that have been made at developing a suitable land use classification scheme for use with orbital imagery, several criteria are proposed. These criteria are not intended to be all-inclusive or precise enough to give a highly refined evaluation. A review and evaluation of the land use map prepared by Prof. Norman J. Thrower and colleagues at U.C.L.A., from Gemeni and Apollo imagery, which has been made against the standards set forth, hopefully will serve to direct attention to some of the serious problems that must be resolved before effective classification schemes can be developed for use with orbital imagery. Several recommendations are then presented as guidelines for further study. Finally, two tentative land-use classification schemes are proposed for further testing with orbital imagery.

15 ANDERSON, James R., Editor.
1977. Remote Sensing of the Electromagnetic Spectrum: A Forum of Remote Sensing in Geography, Omaha: Association of American Geographers. 193 p.

This issue of the Journal focuses on the use of remote sensing in land use mapping and inventory, contains a collection of articles describing the application of remote sensing in the national program of land use and land cover map and data compilation being carried out by the U.S. Geological Survey.

16 ANDERSON, James R., Ernest E. Hardy, John T. Roach, and Richard E. Witmer.
1975. A Land Use and Land Cover Classification System for Use With Remote Sensor Data. U.S. Geological Survey Circular 727.

The framework of a national land use and land cover classification system is presented for use with remote sensor data. The classification system has been developed to meet the needs of Federal and State agencies for an up-to-date overview of land use and land cover throughout the country on a basis that is uniform in categorization at the more generalized first and second levels and that will be receptive to data from satellite and aircraft remote sensors. The proposed system uses the features of existing widely used classification systems that are amenable to data derived from remote sensor sources. It is intentionally left open-ended so that Federal, regional, State, and local agencies can have flexibility in developing more detailed land use classifications at the third and fourth levels in order to meet their particular needs and, at the same time, remain compatible with each national system. Revision of the land use classification system as presented in U.S. Geological Survey Circular 671 was undertaken in order to incorporate the results of extensive testing and review of the categorization and definitions.

17 ANDERSON, James R., Ernest H. Hardy, John T. Roach, and Richard E. Witmer.
1976. A Land Use and Land Cover Classification System for Use With Remote Sensor Data. U.S. Geo. Survey Prof. Paper 964, United States Government Printing Office p. 28. Washington, D. C.

The framework of a national land use and land cover classification system is presented for use with remote sensor data. The classification system has been developed to meet the needs of federal and state agencies for an up-to-date overview of land use and land cover throughout the country on a basis that is uniform in categorization at the more generalized first and second levels and that will be receptive to data from satellite and aircraft remote sensors. The proposed system uses the features of existing widely used classification systems that are amenable to data derived from remote sensing sources. It is intentionally left open-ended so that Federal, regional, State and local agencies can have flexibility in developing levels in order to meet their particular needs and, at the same time, remain compatible with each other and the national system. Revision of the land use classification system as presented in U.S. Geological Survey Circular 671 was undertaken in order to incorporate the results of extensive testing and review of the categorization and definitions.

18 ANDERSON, R. R., D. McFaden, and S. Daniels.
1977. Application of Remote Sensing to Resource Inventory and Classification in National Parks. Photogramm. Eng. and Remote Sensing. 43(6): 740.

The availability of information from aircraft and space vehicles presents an opportunity to apply remotely sensed information to the changes, and provde, ultimately, a centralized "bank" of information whereby changes may be rapidly identified and remedial measures applied. Three NPS parks have been studied at this point. The results of the study point to the following conclusions: (A) Methodology for determining past vegetational history of the areas; (B) Data collection systems oriented to remote sensing as in information base; (C) Resource classification system oriented toward management objectives in each of the three types of parks; and (D) Methodology for data presentation compatible with the long-term goal of the NPS to develop a computer based management information system.

19 ANDERSON, Robert.
1975. Procedures for the Grand Platte River Basin Multi-objective Land Use Planning Study. For. Div., Missouri Dept. of Cons. 76p.

This land-use planning project was initiated with the Missouri Department of Conservation by the United States Forest Service to intensively map the forest resources of the Grand-Platte area, inventory and analyze the quality of the forest wildlife habitat conditions and to assess the existing forest watershed conditions by conducting an erosion and sedimentation survey.

20 ANGSUWATHANA, et al.
1974. ERTS (Landsat) Applications in Thailand - A Progress Report, In Internat. Symp. on Remote Sensing of Environment, 9th, Ann Arbor, 1974, Proc.: Ann Arbor, Mich., Env. Res. Inst., v. 1:341-361.

Analyses of ERT-1 imagery conducted by four Royal Thai Government agencies responsible for survey, inventory and development of natural resources are described. Visual interpretation of single band and color composite images was augmented and verified by ground checks and aerial photographs. Preliminary computer printouts of one scene have been found accurate and helpful. Agriculture, forestry, land use, and geological mapping are illustrated. The work will be reported in more detail to NASA.

21 AREOLA, O. and A. Faniran.
1977. A Framework for Land Resources Evaluation. Regional Planning and National Development in Tropical Africa. Ibadan Univ. Press: 233-245.

After a brief definition of land resources and land resource survey methodology and practice, some important features of land resource surveys conducted in Nigeria are reviewed. (1) Surveys have been largely ad hoc and uncoordinated; (2) Few government and quasi-government departments and bodies have comprehensive plans covering the whole country or state: The emphasis has been on "project" areas, often defined without a reconnaissance survey; (3) Very little interaction between bodies responsible for natural resources study and development; (4) Most surveys have been undertaken by foreign experts brought in for specific surveys; (5) Most land surveys are concerned with soil or related (land use, agricultural projects). A framework is suggested for land resource evaluation studies which will provide the needed standardization of approach and reliable source material for scientific planning.

22 ARTHANARI, T. S.
1977. Integration of Surveys with Prescribed Probabilities of Selection Samples. 41st Session of International Statistical Inst., New Delhi, India. 5-15 Dec.

23 ARVANITIS, L. G., and Afonja, B.
1971. Use of the Generalized Variance and the Gradient Projection Method in Multivariate Stratified Sampling. Biometrics, 27: 119-127.

The authors advocate the use of the generalized variance of the sample means--the determinant of the variance-covariance matrix $D(\bar{y})$ of the means--as a loss function in multiparametric sampling allocation. In stratified random sampling, the loss functions for bivariate and trivariate cases are derived. The sampling allocation is stated as a nonlinear programming problem whose "best" solution is determined by the Gradient Projection Method. A numerical example from forestry is given only for the bivariate case.

24 AVERY, T. E.
1964. To Stratify or Not to Stratify? Journal of Forestry 62(2): 106-108.

The efficiency of a timber cruise is normally improved by stratified sampling, and a forest type map often provides a useful basis for stratification. Variances for forest types or strata can be derived from estimated ranges in volume per acre. These preliminary computations permit an allocation of field samples on the basis of strata variances or relative stand values rather than on the basis of stand areas. As a result, ground plots are concentrated in those stands where the greatest degree of accuracy is desired.

25 AVERY, T. E.
1974. Management-Based and Broad Inventories. In Inventory Design and Analysis. Proc., Workshop Sponsored by the Inventory Working Group, SAF, Colo. State Univ., p. 186-194.

For purpose of discussion, at least three diverse categories of forest inventories may be recognized. These are (1) intensive inventories for providing information on a stand or compartment basis, (2) management-based, or extensive inventories designed to provide information about an entire forest property that is administered under a single ownership, and (3) regional or national inventories that are concerned with forest resources information across a wide range of vegetation types, management units, land ownership classes, and political subdivisions.

26 AVERY, T. E.
1975. Natural Resource Measurements. Second Revision. McGraw-Hill Book Co. New York, New York, p. 339.

Textbook explaining sampling and measurements of the range, wildlife, watershed, and recreation resources.

B

01 BAILEY, Robert G.
1978. Description of the Ecoregions of the United States. U.S.D.A. Forest Service. Intermtn. Reg., Ogden, UT. 77 p.

This manual briefly describes and illustrates the nation's ecosystem regions as shown on the 1976 map, "Ecoregions of the United States." The description of each region includes a discussion of land-surface form, climate, vegetation, soils and fauna.

02 BAILEY, Robert G., R. D. Pfister and J. A. Henderson.
1978. The Nature of Land and Resource Classification - A Review. Jour. of Forestry. 76(10): 650-655.

Various approaches to classification have been developed and applied at the local and regional scale. The taxonomic approach seeks to establish land units by grouping sites with similar properties. Under the regionalization approach, land is subdivided into natural units on the basis of spatial patterns that affect resource use and natural processes. The appropriate system depends on the kind of information needed.

03 BAKER, Kenneth Robert.
1969. Control Policies for an Integrated Production and Inventory System. PhD Thesis, Cornell Univ., 208 p.

The subject of this research is the single-facility system in which the production and inventory functions are interdependent and in which the scheduling and replenishment processes interact. The objective of the study is to combine the concepts of production scheduling and inventory control in continuous-time, infinite-horizon models and characterize various operating policies in the integrated environment.

The simulation results show that the use of updated system information is significantly preferable to static, independent operation of production control and inventory control.

04 BALLOU, Ronald Herman.
1965. Multi-Echelon Inventory Control for Interrelated and Vertically Integrated Firms. Ph.D. Thesis. Ohio State University. 233 p.

A basic problem in this study was (1) to determine whether single-stage inventory models would yield satisfactory results in a multi-echelon inventory system or whether a model with greater inclusiveness of pertinent variables that could account for the cost-price interdependencies was required, and (2) to ascertain the inter-firm inventory policies of the firms in a multi-echelon inventory system that would yield maximum profits.

A second problem was to explore the impact of transportation costs as a relevant factor in inventory models. Existing inventory formulas have not singled out movement costs as a specific factor.

05 BALSTON, D. M.
1978. Image Analysis System for Earth Resource Surveys. Systems Technology. 1978 (28): 14-24.

06 BARE, Bruce B.
1978. Natural Resource Management Information Systems: Their Role in Today's Decision Environment: Moderator's Comments. Integrated Inventories of Renewable Resources. Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., Forest Serv., U.S.D.A., Fort Collins, CO. p. 350-353.

Computerized management information systems for natural resource applications consist of four principal components: (a) a resource data base -- usually spatially structured, (b) an information processing system, (c) a decision analysis system and (d) a decision maker. The function and importance of each of these components is briefly described with particular emphasis placed on geographic or spatially-oriented natural resource information systems. Lastly, three observations concerning the current role of natural resource information systems for aiding decision makers are presented.

07 BARE, Bruce B. and J. C. Cook.
1974. A Multiple Resource Wildlands Information System for Environmental Impact Assessment Modeling. Proc. of a Workshop on Inventory Design and Analysis, Fort Collins, CO., 23-25 July 1974. p. 220-245.

The subject of this paper concerns the resource data base and information storage and retrieval system which has been developed to support model development and to operate in concert with the system simulation model. Following a discussion of natural resource information systems in general, a brief description of the SVEN information system is presented. This is followed by a discussion of computer requirements, limitations, and capabilities of the system.

08 BARE, Bruce B. and Gerald F. Schreuder.
1974. Wildland Management and Environmental Quality: A Multiple Resource Simulation Model. In Proceedings of a Conference on Nonpoint Pollution in Forest Resources Management, College of Forest Resources, University of Washington, Seattle, p. 44-52.

09 BARE, Bruce B. and Gerald F. Schreuder.
1975. Environmental Impact Assessment Modeling and Land-Use Planning. In Systems Analysis and Forest Resource Management: Proceedings Workshop by SAF, University of Georgia, Athens, p. 21-36.

Describes a computerized planning system useful for examining the physical, economic, and environmental consequences of alternative wildland use decisions. The system consists of a set of simulation models linked to a geographic data base by an information storage and retrieval subsystem. System structure is discussed in the context of an integrated system model developed to facilitate an evaluation of the environmental consequences of alternative land uses and manipulations at varying scales of space-time resolution. Uses to date suggest that the system is a valuable aid to land-use planners if they possess the information required to calibrate the models.

10 BARGER, Roland L. and Peter F. Ffolliott.
1969. Multi-Product Timber Inventory. For. Prod. J. 19(11): 31-36.

Multi-product timber inventory methods described provide a means of estimating the suitability of standing timber for a wide range of products. The occurrence and severity of basic stem characteristics related to quality-knots, fork, sweep, crook, and the like - provide a basis for evaluating product potential.

11 BARNARD, Joseph E.
1974. Sampling with Partial Replacement Contrasted with Complete Remeasurement Inventory Design: An Empirical Examination. In Monitoring Forest Environment Through Successive Sampling, June 1974. State University of New York, College of Environmental Science and forestry, p. 485-390.

Empirical data from the Delaware and Rhode Island inventories demonstrated the greater efficiency of volume and area estimation that is possible with SPR in contrast with complete remeasurement. The data also demonstrate the increasing efficiency of SPR when major shifts occur in the resource.

2 BARNARD, Joseph E.
1978. Example of a Specific Regional Inventory: The United States Northeastern Double Sampling with Partial Replacement Design In Joint Meetings of IUFRO Groups, International Union of Forest Research Organizations. National Forest Inventory. June 18-26, 1978. Buchurest, Romania. p. 620-628.

The application of double sampling with partial replacement to the reinventory of 105 million acres (42.5 million ha) in the northeastern United States is discussed. Specific details of the application are provided. Special considerations such as data processing and local data summaries also are discussed.

13 BARNARD, Joseph E.
1978. FINSYS - A Tool for the Processing of Integrated Resource Inventory Data. Integrated Inventories of Renewable Resources. Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For Serv., U.S.D.A., Fort Collins, CO, p. 332-335.

Resource inventory data processing requires quick, low-cost procedures for developing desired information. A computer system--FINSYS--is presented here. It is a generalized system with the flexibility to allow the user to specify the procedures for both data handling and table construction. The components of the system are described, and its development and use since 1964 are discussed.

14 BARNARD, Joseph E. and Larry Letourneau.
1974. Data Processing Systems for Large Inventory. In Inventory Design and Analysis: Proceeding Workshop by Society of American Foresters, Colorado State University, Fort Collins, CO. p.137-149.

What really matters in forest-inventory data-processing is the ability to quickly and at relatively low costs develop the desired inventory information. FINSYS is a generalized processing system that has met these requirements in a noteworthy form during the past decade. It not only has met individual users' immediate needs, but it also has shown an ability to grow with the user. We feel that its utility will continue to increase in the next decade. Since it is essentially a unit record processor for any data, we anticipate its increased use in inventory applications outside of forestry. The major drawback to use of the system seems to be ignorance of its existence.

15 BARRETT, James P., and David S. Linden.
1978. Using Short Programs in Natural Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 325-327.

The use of short programs for natural resource inventories with limited or special purpose objectives as an important complement to larger computer systems is stressed. Illustrations include a BASIC program to summarize data from a deer browse survey based on stratified random sampling and a hand computer program to summarize data from a simple timber survey.

16 BARRETT, James P. and Mary Nutt.
1975. Survey in the Environmental Sciences--A Computer Approach. Project Compute, Hanover, N.H. 319 p.

Easy to follow text book on the use of BASIC programming to solve various resource sampling problems.

17 BAUMGARDNER, M. F., et al.
Using Satellites and Computers to Inventory the Natural Resources of the Tempisque Valley, Costa Rica: West Lafayette, Incd, Lab. for Applications of Remote Sensing, Purdue Univ., Rept. to the Inter-Am. Devel. Bank and Govt. of Costa Rica, 58 p.

18 BAXTER, F. P., C. W. Smart, E. E. Howard and E. B. Rowland.
1976. Tennessee Valley Authority Land Analysis System. Proceedings, Resource Data Management Symposium, August, Purdue University, West Lafayette, Indiana. 79-104 p.

The Land Analysis System consists of a team-oriented decision process supported when appropriate by a computer-assisted geographic information system. The present computerized system deals with locational information abstracted in cell or grid format. Future development will combine both cell and polygon technology into a hybrid system. The Land Analysis System uses a geographic referencing system based on longitude and latitude. Geodetic cells (bounded by lines of longitude and latitude) are referenced to standard 1:24,000 and 1:250,000 scale base maps. Cell size used varies with objectives of the analysis with a range between 0.6 and 170 acres but most commonly 2.7 acres. Use of the system to date includes analysis support of reservoir land planning, county-wide water quality planning, and development of site specific management plans for public lands. Additional future uses scheduled include power

plant site evaluation and power transmission corridor routing. The more comprehensive system now being planned and developed will attempt to gain optimum benefit for the Tennessee Valley Authority (TVA) and region through the use of a shared system and data bases serving diverse functions and programs requiring geographically referenced data. A phased approach to planning this system is discussed.

19 BEAUBIER, P. H., et al.
1974. Land Use Information Series. In Canada's Northlands: Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands, (April 74) Ecological Land Classification Series No. 0. p. 89-90.

The Northern Land Use information Map Series, prepared by the Lands Directorate for the Arctic Land Use Research (ALUR) Program of the Department of Indian Affairs and Northern Development, aims to provide a convenient information base to assist in regional land use planning and in a managed approach to northern development and environmental protection. The maps integrate a wide range of data on renewable resources and related human activities at a scale of 1:250,000. Some of the information included on the maps requires specific data on specialized topics. For these units, the series relies on direct inputs by the Canadian Wildlife Service (CWS), the Fisheries and Marine Service (FMS) and by Canada Land Inventory (CLI) personnel. The project also relies on the cooperation and assistance of other federal government departments, the territorial governments, private research groups, and local residents of the Yukon Territory and the Northwest Territories.

20 BECKETT, P. H. T.
1974. Statistical Assessment of Resource Surveys by Remote Sensors. Natural Resources. In Environmental Remote Sensing Applications An Achievements Papers. Bristol Symposium. 1972. p. 9-27.

Published discussions on the use of remote sensing procedures for obtaining information about natural resources or the environment contain many unsupported value judgments (e.g. 'better than', 'more information than'). The utility of remote sensing procedures should be assessed on the truth and precision of the information (statements) they provide, and the costs of obtaining it. This paper lists the kinds of statement which may be required from remote sensors, and offers a preliminary review of methods for judging the success of remote sensors in providing them. The same methods may be used for the quality control of resource surveys by remote sensors, performed under contract.

21 BECKETT, P. H. T. and R. Webster.
1965. A Classification System for Terrain. Military Eng. Exp. Estab. Interim Rpt. No. 872. Christchurch, Hampshire, England, p. 247.

22 BEEMAN, Larry E.
1978. Computer-Assisted Resource Management. In Integrated Inventories of Renewable Resources, Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO., p. 375-381.

Successful planning processes for allocating natural resources recognize (1) the interrelationships of natural resources and processes, (2) the appropriate socio-economic forces, and, (3) the link between information and the quality of resource decision-making. A computer program, IMGRID, is briefly described that can assist decision-makers in data handling problems associated with resource planning/management.

23 BEERS, Thomas W.
1978. Developing Efficient Estimation Techniques for Integrated Inventories. In Integrated Inventories of Renewable Resources, Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For Serv., U.S.D.A., Fort Collins, CO. p. 270-275.

In the formulation of the general directions for a multi-purpose inventory, the designer must consider numerous estimation procedures. Variable probability selection, such as in point or line sampling, frequently provides very simple and efficient field and analysis methods. The general procedure for developing the necessary estimation formulas is discussed in this paper and several examples are presented. The challenge for the inventory designer is to assemble the appropriate set of techniques into one integrated field procedure.

24 BEFORT, William A., Robert C. Heller, and Joseph J. Ulliman.
1977. Idaho Land-Use Mapping from LANDSAT Transparencies: Station Note No. 28, University of Idaho, Forest, Wildlife and Range Exp. Station.

Visual Interpretation of LANDSAT false-color composite imagery enables the senior author to map land use for the entire state of Idaho in two months' time during the summer of 1975. The mapping was part of the initial stage of the Pacific Northwest

Regional Commission's Land Resources Inventory Demonstration Project; results are now published in the form of black-line overlays at scales of 1:250,000, 1:500,000 and 1:1,000,000.

25 BELCHER, Donald J., Ernest E. Hardy and Elmer S. Phillips.
1971. Land Use Classification with Simulated Satellite Photography. U.S.D.A. Agr. Inform. Bull. 352. 27 p.

Imagery expected from the Earth Resources Technology Satellite (ERTS) was simulated by reduction of conventional black and white aerial photography (scale 1/20,000) to the small scales (e.g., 1/2,560,000) that would result from photographing large areas of the ground at satellite altitude. Small sections of the reduced negatives were then enlarged for land use interpretation tests. It was concluded that the classification system now used by Economic Research Service, U.S.D.A., in its inventory of major land uses would be compatible with satellite photography. Data for the following categories cannot be obtained from satellite photography: ownership, end-use for specific crops; some transitional vegetation and multiple-use areas.

26 BELKNAP, R. K. and J. G. Furtado.
1967. Three Approaches to Environmental Resource Analysis. Conservation Foundation, Wash., D. C. p. 102.

The first purpose of this study was to select three outstanding approached developed to identify, analyze, and evaluate the natural and man-made resources that make up the physical environment and to outline their procedures. More particularly, the study examined: (1) How the three individuals identified environmental and spatial patterns beyond single-factor analysis and simple spatial location; (2) How they identified and evaluated the key elements and forces that lend quality to the physical environment; (3) How they reviewed the analysis material for incorporation into the planning process; and (4) Whether they treated environment as a resource per se or only in terms of the given planning purposes.

27 BENSON, A. S.
1971. "Evaluation of Wildland Resources on the NASA Bucho Lake Test Site." In R. N. Colwell, et al., Monitoring Earth Resources from Aircraft and Spacecraft, NASA SP-275, G.P.O., Washington, D. C. p. 111-117.

High-altitude photography can be extremely useful in evaluating wildland resources. Because so few photographs are needed to cover a given area as compared to conventional low-altitude photographs.

evaluation is simplified. Infrared Ektachrome was judged best for delineating ground covered boundaries, although Pan-25A was satisfactory for delineating several cover types. Except for delineating bodies of water, watercourses, and riparian hardwood, IT-89B proved unsatisfactory for overall ground-cover typing. Sequential photography, if taken over a number of years, will yield valuable information concerning the consequences of vegetation manipulation and the yield of snow.

28 BENSON, A. S., W. C. Draeger, and L. R. Pettinger.
1971. Ground Data Collection and Use. Photogramm. Eng. 37(11): 1159-1166.

During the past two years, extensive studies have been conducted out in the Phoenix, Arizona area to ascertain the degree to which sequential high-altitude aircraft and spacecraft imagery can contribute to operational agricultural crop surveys. Data collected on the ground within the test site constituted an essential component of the three phases of the survey: (1) familiarization with the area and design of preliminary evaluation experiments, (2) training of interpreters, and (3) providing the basis upon which image interpretation estimates can be adjusted and evaluated. This paper will discuss the problems encountered when gathering extensive sequential agricultural ground data, requirements for such data in terms of amount and timing, methods of collecting, handling and compiling such data in a useful form, and the use of ground data in the survey evaluation process.

29 BERK, R. A.
1977. Survey of Integrated Statistical Computer Packages. Behavior Research Methods and Instrumentation 9(3): 277-280.

30 BETTWY, Andrew.
1978. Resource Inventories and Agency Decisions. In Integrated Inventories of Renewable Natural Resources, Gen. Tech. Tept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S. Agric., Fort Collins, CO. p. 1-3.

Paper places land management agency within its perspective: policy, responsibility. Further development of this perspective includes the scientific community, organized to create a system of resource inventory methods which would be of best service to the administrator of a land agency. Paper raises question: what adjustment to existing resource inventory system would make the inventory more useful. Paper responds to that question with proposed adjustments.

31 BIESTERFELDT, Robert C. and Stephen G. Boyce.
1978. Systematic Approach to Multiple-Use Management. Jour. Forestry 76(6): 342-345.

A computerized system is available to help make decisions about multiple-use management. On a forest, production of individual benefits, such as turkey habitat, is mathematically related to rotation lengths and sizes of openings for reproduction. From these equations, which are independent of one another, the benefits that will accrue from a management alternative are computed and displayed. A manager can, therefore, base his decisions upon benefit production. Once a combination of benefits is chosen, the system indicates the rates of timber harvest and the sizes of openings required to produce that combination.

32 BLAIR RAINS, A., and M. A. Brunt.
1971. An Evaluation of Air Photography for Land Resource Surveys in the Tropics, In Internat., Symp. on Remote Sensing of Environment, 7th Ann Arbor, Mich., 1971, Proc.: Ann Arbor, Mich., Mich. Univ., 3:2319-2327.

This paper examines problems in comparative tests of aerial photography for land resource surveys in the tropics, and describes the results of colour photography tests in Malawi and Kenya.

33 BONNER, G. M.
1972. Forest Sampling and Inventories; a Bibliography. Forest Management Institute, Ottawa, Canada. Internal report FM R-24, 27 pp.

A list of references selected from 1945 to 1972. In addition to those articles dealing exclusively with forest sampling or inventories, many articles are included which cover related aspects, e.g., the measurement of tree characteristics on aerial photographs. Reports on methods of constructing volume tables are included.

34 BONNER, G. M.
1975. The Error of Area Estimates from Dot Grids. Canadian Journal of Forest Research. 5(1):10-17.

The scarcity of information about errors of area estimates from dot grids has led to the use of dense grids (100 dots/in.^{2} or 15.5 dots/cm^2) and time-consuming checking procedures, in the hope that estimates are sufficiently precise. Results of this study indicate that, in many applications, much coarser grids can be used and that,

in general, the effort involved in obtaining precise estimates is relatively small. These results also provide data useful to the prediction or estimation of errors of area estimates, which thus eliminates the checking procedures.

The results obtained from this prediction approach should enable foresters to obtain better area estimates and to have more confidence in them. The comparative ease with which error levels can be estimated and low error levels attained should also contribute to better forest inventory data.

35 BONNER, G. M.
1978. Pilot Study for Canadian Forest Resource Data System. Forest Management Institute Information Report. RMR-X-122. 28p.

Current data on Canada's forest resources are incomplete, inaccurate and insufficiently location-specific. To eliminate these deficiencies, the Forest Resource Data Program of the Forest Management Institute was assigned the task of developing a new data system. The resulting Canadian Forest Resource Data System (CFRDS) was subsequently tested. This report describes the procedures, problems, cost and manpower requirements, and results of the pilot study.

The pilot area of about 250,000 km was located in central Saskatchewan. Provincial and federal forest resource data were summarized using the townships as summary units, and reclassified and merged using a new area-based classification system. A mini-computer was used for this purpose, and also to extract data from the resulting data base. Attempts to obtain data from other sources, and to use a data base management system to extract data, were unsuccessful due to a lack of time and resources.

Tabular data summaries of area and volume were extracted from the data base using a number of different classifiers and classes. Also, color maps were produced using an automated mapping system, showing attributes of individual townships.

The study took one year to complete, required 2.6 man-years of labor, and cost $70,000. It is estimated that, if done operationally, these figures would be cut in half.

The pilot study successfully demonstrated the practical application of the Canadian Forest Resource Data System: data from different sources can be combined and summary tables and location-specific maps of the data can be produced. The experience and information gained are necessary and sufficient for a nation-wide implementation.

36 BONNER, G. M. ed.
1978. A Guide to Canadian Forest Inventory Terminology and Usage. Canadian Forestry Service, Environment Canada, Ottawa, 2nd 3d. 57 pp.

Sector Committee 8.1 (Forestry) of the Metric Conversion Program recommended that a committee be established to resolve some problems of forest inventories in Canada: problems caused by metric conversion, by a lack of common terminology, and by differences between forest inventories. This publication is a result of those problems.

37 BORN, J. David.
1978. Renewable Resources Evaluation Data Base and Sampling Design Procedures Handbook for the Rocky Mountain Resource Supply Region - Draft. Intermountain Forest and Range Experiment Station (Nov.). Misc. paging.

This handbook describes the sampling framework to be used by RWV-INT 4101, Renewable Resources Evaluation (RRE) for collecting basic renewable resource data. Included is a description of a data base sampling system for forest and range lands, and alternative sampling designs for resource inventories using the sampling system.

38 BOTTOMS, Kenneth E. and E. T. Bartlett.
1975. Resource Allocation Through Goal Programming. Jour. Range Management. 28(6): 442-448.

The problem with using linear programing in natural resource management is that only one objective is allowed, and organizations seldom have a single goal. The concept of goal programing evolved due to unsolvable linear programing problems and the occurrence of conflicting multiple goals. A goal programing model that enables the manager to program multi-objective problems in Northern Colorado is presented. Goal programing is particularly applicable as a planning agent to agencies, such as U.S.F.S. and U.S.B.L.M., where multiple resource management is essential. It is shown to be a flexible decision aiding tool that can handle more efficiently any decision problem formulated by linear programing.

39 BOYD, Donald Loren.
1971. A Multiple Resource Model for a Batch-Processing Multiprogramming System. Ph.D. Thesis, University of Iowa. 125 p.

A batch-processing multiprogramming system is modeled as a multiple resource system. The interactions and relationships among the methods of allocating individual resources are examined. The relationships and variables found are then related to a set of measurements which may be used to evaluate an actual system.

The first model developed is a closed, cyclic two-stage model with a fixed number of jobs.

The two-stage model is then expanded to a three-stage model.

The three-stage model is then analyzed using hyperexponential service time distributions, a geometric CPU request distribution, and three specific CPU dispatching algorithms.

The effects of system balance, number of jobs in the system and CPU dispatching algorithm are explored, based on numerical solutions to the equilibrium state probabilities of the three-stage model. A minimal set of system measurements is suggested for system evaluation. These measurements are related to the equilibrium mean-value relationships found. Finally, the measurements of a specific system are used, in conjunction with the analysis, to give an indication of how fine descriptors can be obtained from gross measurements.

40 BROWN, G. S.
1959. Bird's Eye View: Malayan Forester, 22: 208-212.

The author calls the attention of his fellow foresters in Malaya to the merits of forest reconnaissance from the air, and to the facilities available for this.

41 BRYANT, Emily S., Arthur G. Dodge, Jr., and Samuel D. Warren.
1978. Satellites for Practical Natural Resources Mapping. A Forestry Test Case. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55., Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p.219-226.

In this cooperative project we compare computer classified Landsat maps with a recent inventory of forest lands in northern Maine. Over the 485,000 acre area, acreages of softwood, mixed wood, and hardwood agree to within 5 percent. These results show enough potential to warrant our further development of computer-satellite mapping techniques for use in practical forest inventories.

42 BUCHMAN, Roland G.
1978. Timely Resources Information Through Process Modeling: The North Central System Experience. In Integrated Inventories of Renewable Natural Resources, Proceedings of the Workshop. (Tucson, Arizona, Jan. 8-12, 1978.) Gen. Tech. Rept. RM. 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 334-349.

Forests are complex dynamic systems characterized by multiresources, interacting components, and diverse processes. Characterization of these systems must include the mechanisms of change as well as an inventory of their current state to provide timely resource information.

The North Central Forest Experiment Station has developed a generalized forest growth projection system for representing a complex forest ecosystem. With this system the known initial state of the forest (the inventory) is moved through time based on the underlying processes (the projection system). Special emphasis is placed on birth, growth and death.

Understanding these processes under the wide range of forest conditions encountered in a region and subsequent application of the system set the dimensions of the sampling and recording problems. Consideration must be given to the components of the resource, to continuity, and to processes under diverse forest conditions.

43 BUCKMAN, Robert E. and Roger D. Fight.
1974. Multi-resource Inventories--Resolving Conflicts. In Inventory Design and Analyses Proc., Workshop Sponsored by the Inventory Working Group, SAF, Colo. State Univ., p. 181-185.

An analysis of the role of multi-resource inventories in resolving conflicts is presented. We conclude that conflicts in resource decisionmaking does not result primarily from the lack of inventory data. However, we also conclude that such inventory data are an essential link in resource decisionmaking and can play an important role in focusing the conflict on the real issues.

44 BURKHART, H. E., et al.
1978. Allocating Inventory Resources for Multiple-Use Planning. Canadian Jour. of Forest Research. 8(1): 100-110.

A user oriented approach to allocated inventory resources for multiple-use planning is presented. The sequence used in the

approach is to determine (1) the decisions to be made with the aid of inventory data, (2) the data needed to soundly base the decisions, and (3) the impact of sampling error in the data on the decisions. Sample intensities that minimize the cost of obtaining data plus the expected losses from using the data to make decisions were determined. A cost plus loss minimization framework for multiple-use planning inventory was developed and applied to a case study on a U.S. Forest Service planning unit. Results indicated that the procedure should provide useful guides for allocating sampling resources.

45 BUTLER, Kent S., William A. Gates, and Brent H. McCown.
1977. A Resource Data Management System, GRASP: Description of a Land Resource Data Base. RF Monograph 76-11 IES Report 88. University of Wisconsin, Madison. 125 p.

The development of a spatially oriented land resource data base and the major steps in compiling, encoding, and accessing the data are fully documented so that other investigators and prospective users can use this report as a reference manual. The data base consists of 126 resource variables, describing the topography, soils and geology, coastal features, vegetation, hydrology, and land use/ownership of a region along the Wisconsin Lake Superior shore. The data base is called the RIPA (Resource Information for Planning and Analysis). RIPA was encoded and manipulated in a grid-cell format using the computer-based land resource data system, GRASP.

46 BUTTERY, Robert F.
1978. Modified Ecoclass - A Forest Service Method for Classifying Ecosystems. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. (Tucson, Arizona, Jan. 8-12, 1978.) Gen. Tech. Rept. RM. 55, Rocky Mtn. Forest and Range Exp. Stn., Serv., U.S.D.A., Fort Collins, CO. p. 157-168.

Modified ECOCLASS, a hierarchical, four-system method for classifying terrestrial and aquatic ecosystems, is a modification of the ECOCLASS method described in 1973. Modifications include the addition of a landform system to the three existing systems of vegetation, soil and aquatic, and improvements in each of these systems. The method provides flexibility in establishing a framework for use by land managers in securing integrated resource information for management decisions.

C

01 CABALLERO, Miguel,
1978. Multi-Resource Inventory in Mexico. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. (Tucson, Arizona, Jan. 8-12, 1978) Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 420-429.

A summary of renewable natural resource inventories being carried out in Mexico is briefly discussed. The discussion emphasizes forest resources but some information about inventories of arid regions, soils, wildlife, water resources and range is also provided.

02 CARGO, David F. and Arthur L. Ortiz.
1968. Summaries of New Mexico Resource Inventory Reports. State Planning Office, Santa Fe, New Mexico. 129 p.

The New Mexico State Planning Office has initiated and coordinated the preparation of a series of reports on the State's resources. These studies both summarize available data and present original findings about various subjects of particular importance to the State and its citizens. The major categories in which the reports are grouped are: economic resources, environmental resources, human resources, and state government administration. They indicate the perspective of the Planning Office is that statewide resources development planning should encompass the broad range of concerns and responsibilities of state government itself and, more particularly, the executive branch.

03 CARNEGGIE, David M., L. R. Pettinger, and C. M. Hay.
1971. Analysis of Earth Resources in the Phoenix, Arizona Area. In Monitoring the Earth Resources from Aircraft and Spacecraft, NASA SP-275, G.P.O., Washington, D. C. p. 15-65.

The procedures used in attempting to recognize various land-use categories (agriculture, range, geologic, hydrologic, and cultural) will be discussed separately, because different interpretation techniques were employed to study the space and aerial photos, depending upon the nature or characteristics of the particular resources. The purpose of this study has been to determine the usefulness and/or limitations of sequential high-altitude photography for evaluating and monitoring earth resources.

04 CASSELL, Robert F.
1976. Considerations in the Design of a Forest Resource Information System. Proceeding. Resource Data Management Symposium, SAF, Purdue University, West Lafayette, Indiana. p. 113-141.

Simpson Timber Company has been in the process of designing a computerized, in-place forest resource information system. This paper describes the steps of the design process with discussion of some of the situations and problems encountered.

05 Center for Studies in Food Self-Sufficiency.
1977. A Research Report on Developing a Community Level Natural Resource Inventory System. Burlington, VT. 54 p.

The document reports on the development of a computer mapping system and on its application to land and resource planning at a local level. The paper reviews existing systems, describes the program developed, and explains how the program was used in two Vermont towns.

06 CHAPMAN, David D.
1978. Design of Integrated Natural Resource Surveys. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 282-290.

Natural resource surveys are integrated to increase statistical efficiency or reduce survey cost. The key to survey integration is the dependent selection of surveys and the use of information exchanged between surveys. Demographic and agriculture surveys illustrate some basic principles of survey integration.

07 CHAPPELLE, Daniel E.
1976. How Much is Information Worth? Proceedings: Resource Data Management Symposium, August, Purdue University, West Lafayette, Indiana. 142-153 p.

Information, like any other good or service, may be valued in terms of exchange values or in terms of utility received by the possessor. In view of measurement problems encountered in the utility approach, the exchange value approach, although extremely limited in scope and application, appears most feasible. The value of information is defined as the difference between the present net value of benefits accruing to the organization because of the possession of additional information minus costs involved in generating the

additional information. Information quality should be increased until marginal costs are equal to marginal benefits. Principal problems in the economics of information include measurement of benefits and quantification of the amount of risk and uncertainty that is acceptable to decision makers.

08 CHAPPELLE, Daniel E., et al.
1977. Land Use Inventory and Information Systems. Fargo, ND, North Cent. Res. Strategy Comm. on Natural Resource Development, Task Force Land Use Information Systems, Task Force Rept. 1. 36 p.

This report contains five papers on (1) nature of land use problems, (2) needs of land use decision makers, (3) technical issues of land use information systems, (4) research issues and priorities in information systems for land use planning, and (5) role of experiment stations in land use information systems. It also contains three appendices on (1) North Dakota resource inventory and monitoring system, (2) information needs for open-space planning, and (3) alternative methods of land use management.

09 CHOWDHURY, M. I., Elahi, K. Maudood.
1977. Land Utilization and Ecological Aspects in the Sylhet-Mymensingh Haor Region of Bangladesh: An Analysis of the Landsat Data, In Internat. Symp. on Remote Sensing of the Environment, 11th, Ann Arbor, Mich., 1977, Proc.; Ann Arbor, Mich., Environmental Research Inst. 2:1183-1195.

The objectives of this paper are to indicate whether remote sensing data from Landsat (ERTS) imageries could be used in identifying, evaluating, and mapping land use patterns of the Haor area in Bangladesh. In the present study one Landsat imagery of the 16 covering Bangladesh provided sufficient coverage for the Haor region of Sylhet-Mymensingh districts. Selected cloud-free imageries of the area for the period 1972-75 were studied. Imageries in bands 4, 5 and 7 were mostly used. The method of analysis involved utilization of both human and computer services of information from ground, aerial photographs taken during this period and space imageries.

The principal outcome of the Landsat data analyses on this region have been classified under the following heads in the text: general findings, technical findings, and ecological evaluation of land use aspects.

10 CHRISTIAN, C. A.
1957. The Concept of Land Units and Land Systems. Proc. of the 9th Pacific Sci. Con., 20: p. 74-80.

11 CHRISTIAN, C. S.
1957. Methodology of Integrated Surveys. In Aerial Surveys and Integrated Studies Proc. Toulouse Conf. 1964, UNESCO, p. 233-80.

12 CLARY, Warren.
1969. Increasing Sampling Precision for Some Herbage Variables through Knowledge of the Timber Overstory. J. Range Manage. 22:200-201.

The relative precision of estimates made from an original sample of herbaceous understory can sometimes be doubled by using auxiliary information about the timber overstory to obtain a regression estimate. Improvements can be made in the estimates of total herbage production, total perennial grass production, and total forage consumed.

13 CLAXTON, H. Dean, and Giuseppe Rensi.
1972. An Analytical Procedure to Assist Decision-Making in a Government Research Organization: Mathematical Model. U.S.D.A., For. Serv., Res. Pap. PSW-80, 20 pp.

An analytical procedure to help management decision-making in planning government research is described. The objectives, activities, and restrictions of a government research organization are modeled in a consistent analytical framework. Theory and methodology is drawn from economics and mathematical programing. The major analytical aspects distinguishing research from other forms of economic activities are examined. The characteristics and potential uses of a management information system are outlined.

14 COCHRAN, William G.
1963. Sampling Techniques, Second Edition. John Wiley and Sons, New York. 413 p.

A textbook presenting a comprehensive account of sampling theory as it has been developed for use in sample surveys, with illustrations to show how the theory is applied in practice.

15 COLLINS, W. G.
1972. The Application of Remote Sensing to Locating and Monitoring Under-utilized Land in Jamaica, In Internat. Symp. on Remote Sensing of Environment, 8th, Ann Arbor, Mich., 1972, Proc.: Ann Arbor, Mich., Environmental Research Inst. Mich., 1: 103-115.

This project is a pilot study of the existing land use of the parish of St. Catherine, Jamaica. Apart from three months' field work spent in compiling a key, the land use data was obtained entirely from the interpretation of aerial photographs. Over 30 land use maps were produced at a scale of 1:12,500 showing 21 different crops or land use types.

Use was made of the report and maps of the soil survey produced by the Regional Research Centre, University of West Indies. From this soil information the land capability of every soil/slope combination was determined and mapped, so that direct comparisons could be made with the land use maps which had been compiled. This map comparison of actual and potential land use reveals those regions where the land is not being fully utilized, and a set of 1:12,500 maps was compiled to show the precise extent and location of these under-used areas. These maps show where improvements are most likely to be made, and will, it is hoped, serve as a useful guide to those responsible for the development of land resources on the island.

16 COLLOTZI, Albert W. and Donald K. Dunham.
1977. Inventory and Display of Aquatic Habitat. In Classification, Inventory, and Analysis of Fish and Wildlife Habitat. Symposium, U.S.D.I., Fish and Wildlife Service. FWS/OBS-78/76. p. 533-542.

A systematic and uniform approach to the inventory and display of the aquatic habitat has been developed in the Intermountain Region of the U.S. Forest Service. A line transect method is used to measure habitat variables. A rating score for stream habitat variables is displayed for interpretation and analysis by the biologist. A land classification system for the valley bottom lands provides for the display of the aquatic resource at various levels for planning and all associated resources can be inventoried and evaluated on an equal basis.

17 COLWELL, Robert N.
1977. Some Considerations Relative to the Making of Globally Uniform Resource Inventories by Remote Sensing. In Earth Observation Systems for Resource Management and Environmental Control. D. J. Clough and L. W. Morley, eds. p. 183-211.

Covers considerations with respect to timeliness, potential users, information requirements, and application of remote sensing.

18 COLWELL, Robert N. ed.
1971. Monitoring Earth Resources from Aircraft and Spacecraft. NASA, Washington, D. C. NASA SP-275. 170 p.

Reports dealing with wisest possible management of the Earth's resources through the means of obtaining accurate resource inventories quickly and at frequent intervals.

19 COLWELL, Robert N. (Principal Investigator)
1975. An Integrated Study of Earth Resources in the State of California Using Remote Sensing Techniques. Ann. Prog. Rept. for NASA Grant NGL 05-003-404. 22 p.

20 CORLISS, J. C.
1974. ECOCLASS - A Method for Classifying Ecosystems: In Foresters in Land-Use Planning Proc. 1973 Nat. Convention Soc. Am. For., Washington, D. C. p. 264-271.

The purpose of ECOCLASS is to provide a unifying framework for the various functional interests within which research and management can be planned and executed. The classification is hierarchial so it can be used at all organizational levels of planning. The lowest level of the hierarchy consists of preceivable units of the landscape, homogenous in climax and vegetation and form and structor of the land. The classification is developed from existing knowledge.

21 CORNELIUS, John.
1974. Multiple Knapsack Algorithms: Their Application in Areas Involving Multiple Resource Usage. Ph.D. Thesis, Kent State Univ. 340 p.

In the knapsack problem, given the weight and value of each of a number of items one seeks to find that subset which maximizes total value of items chosen while satisfying a constraint on total weight W. Extensions to this basic knapsack problem, both of which are discussed in this body of study, include: (1) consideration of multiple knapsacks j=1, 2, . . ., M, each of which has a total weight constraint Wj, and (2) consideration of value-dependent multiple knapsacks j=1, 2, . . ., M, each of which has a total weight constraint Wj, and within which each item has a different desirability or value depending upon which of the M knapsacks it is assigned to.

Computational experience with both version 4 of the multiple knapsack algorithm and version 2 of the value-dependent multiple knapsack algorithm revealed that four factors contributed to increased problem difficulty: (1) increase in number of items considered for possible addition to the knapsack, (2) increase the number of

knapsacks, (3) increase in total knapsack capacity relative to total item weight, and (4) decrease in the ratio of the initial solution value to the optimal solution value.

The applicability of the multiple knapsack and value-dependent multiple knapsack algorithms in solving management problems is illustrated by representative examples involving the transshipment of goods, subcontracting of tasks, the capital budgeting decision, and employee selection.

The Appendices include a listing of the programs for the Gilmore and Gomory and the Greenberg and Hegerich methods, and for each of the multiple knapsack and value-dependent multiple knapsack algorithms discussed above, as well as detailed computational experience.

22 COSTELLO, Thomas R. and Linn Pettijohn.
1978. Intensive Forest Inventory. A Selected Bibliography. U.S.D.I. BLM Technical Note 319, 61 p.

An annotated bibliography of 172 publications applicable to or dealing with intensive forest inventory.

23 COSTELLO, Thomas R. and H. Gyde Lund.
1979. BLM's Standard, Non-Standard, Stand Inventory System. U.S.D.I., Bur. Land Mgmt., Resource Inventory Notes. BLM 21:6-19.

The BLM is currently developing an information data base through its Strategic Plan to be used throughout the Bureau. Data definitions, coding input and output formats are being standardized.

The 150 million of acres of forested lands that the BLM administers varies from relatively low-valued pinyon-juniper stands of the southwest and spruce types of Alaska to the prime Douglas-fir areas of western Oregon. Our planning system requires that we provide data for each and every stand regardless of its value.

This paper describes how we are going about meeting the objectives of the Strategic Plan and the requirements of the planning system while taking into account the value of the forest being inventoried. Maximum data collection flexibility is provided while maintaining rigid input formats. Stand data based upon photo interpretation, ocular estimates or detailed tree measurements may be entered into the system through a series of standardized required and optional forms.

24 COULOMBE, Harry N.
1978. Toward an Integrated Ecological Assessment of Wildlife Habitat. In Integrated Inventories of Renewable Natural Resources. Gen. Tech. Rept. RM 55, Rocky Mt. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p:5-23.

An analysis of contemporary conceptual aspects of applied ecology and the decision-related information requirements suggests a model for the logical processes of natural resources assessment. The components of this model are defined and related to resolution considerations. Current FWS programs pursuing these components are described.

25 Council on Environmental Quality, Executive Office of the President.
1978. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. Reprint 43 FR 55978-56007 Washington, D. C. 44 p.

Regulation for implementing the procedural provisions of the National Environmental Policy Act; the Environmental Quality Improvement Act of 1969 as amended; the Environmental Quality Improvement Act of 1970; and the Clean Air Act 309; Executive Order 11514, as amended by Executive Order 11991.

26 COUNTRYMAN, David W. (ed.)
1978. Proceedings of a Workshop on Implementing Computer Systems in the Field. Soc. of Amer. Foresters, Washington, D. C. 227 p.

Proceedings of a workshop covering managers' experience, management of computer systems, designing a new computer application for field operation and computers and people.

27 COWARDIN, Lewis M.
1978. Wetland Classification in the United States. Jour. of Forestry. 76(10):666-668.

Wetland is part of a continuum of land types between deep water and dryland. Only one wetland classification was available for the United States prior to preparation of the new system described here, but numerous regional and special-purpose classifications are in use. The new classification is hierarchical, progressing from five systems (marine, estuarine, lacustrine, riverine, and palustrine) at the most general level to dominance types based on plant or animal communities at the most specific level. The system

is currently in use for prototype maps of wetlands of the United States. It is hoped that it may be incorporated into a classification of all land.

28 COWELL, D. W.: G. M. Wickware and R. A. Sims.
1978. Ecological Land Classification of the Hudson Bay Lowland Coastal Zone, Ontario. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. 165-176 p.

An ecological land classification project for the coastal zone of the Hudson Bay Lowland in Ontario has been undertaken. The coastal zone is defined on the basis of hydrologic, vegetative and physiographic characteristics. Ecologically, it represents a distinct zone between Hudson and James Bays and the mature peat complexes of the interior. The coastal zone is, in fact, two Land Regions separated on the basis of climate. It is an internationally important area for migrating, breeding and nesting waterfowl and other shorebirds. The project is designed to provide habitat information relating to these concerns as well as establishing a framework for environmental impact assessment and further scientific research.

Classification is being carried out at four levels: Land Region, Land District, Land System and Land Type. These are defined and examples from the 1977 study area are given. The Land System is the basic mapping level and to date 4000 km^2 of the coastal zone between the Albany River and the Ontario-Quebec border has been classified and mapped at a scale of 1:100,000. During the 1977 field program data on soils, vegetation, hydrology and physiography were collected at 154 sites within this area. This information has been used to formulate the Land System mapping legend and will be analyzed in more detail to form the basis of an ecological report. An example of the legend and its application is provided for an area taken from the Albany map sheet. A brief discussion of the composition and distribution of Land Systems is also presented.

29 COX, T. L.
1977. Integration of Land-Use Data and Soil Survey Data. Photogramm. Eng. and Remote Sensing 43(9):1127-1133.

Remote sensing technology provides a vehicle for the rapid collection of current, detailed land-use data for a variety

of planning purposes. Especially relevant is the spatial context of the data which provides the analyst with a knowledge of the distribution of resources, their areal extent, and proximal relationships. However, the analytical phase can be enhanced by registering the data to a coordinate system which allows combination with other resource data (e.g., soils, topographic). Such an approach was used to increase the utility of remotely sensed interpretations and provide quantitative spatial analyses for a rapidly developing area adjacent to the Black Hills in western South Dakota. Land-use interpretations (Modified Level III, visually interpreted) from RB-57 photography were digitized (congressional township coordinates) using the dominant feature of a 2.5-acre cell. Unpublished soil survey data were similarly digitized and interpretive soils maps generated by means of a computer-assisted process with overlay capabilities. Resulting interpretations of soils data and land-use data were integrated and maps were computer-plotted at several scales to study land-use and soils relationships and temporal land-use changes. This series of analyses also was used in the development of zoning ordinances and maps for the area. The role of remote sensing in land analysis can be enhanced by integrating the data with other resource data through assignment to a coordinate system which is referenced to ground points.

30 CRANDALL, C. J.
1969. Radar Mapping in Panama: Photogramm. Eng., 35(7):641-646.

The APQ-97 side-looking radar system was used to produce a "radar mosaic" of a portion of Darien Province in the Republic of Panama, an area which is persistently covered by clouds so as to prevent successful aerial mapping photography. To serve as control points, 5-foot corner reflectors were placed at 13 locations in the 6,000 square-mile area through the use of helicopters. Six flight lines were successfully flown. The data reduction was handled by Rayheon/Autometric. The resulting uncontrolled radar mosaic was used for geologic and hydrologic purposes.

31 CUNIA, Tiberius.
1965. Continuous forest inventory, partial replacement of samples and multiple regression. Forest Science, 11(4):480-502.

The theory of sampling populations on two occasions with partial replacement of units (SPR) is extended to use multiple regression estimates. It is shown that in general multiple are better than simple linear estimates and in many cases they are much more efficient.

32 CUNIA, Tiberius.
1975. Inventory Designs in Europe and the United States. In Canadian Forest Inventory Methods - Proceedings of a Workshop - Ed. V. G. Smith and P. L. Aird. Univ. of Toronto Press. p.43-61.

The inventory systems of the United States are so similar to those practiced in Canada that the discussion is limited to the outline of those systems that use advanced concepts and at the same time are fully operational. Two main systems were discussed; the first uses SPR and double sampling for stratification, the second one uses 3P sampling. The inventory systems of Europe, with the exception of Switzerland, have not realized the great efficiency that may be added to their basic designs when consecutive forest measurements are not made independently of each other.

33 CUNIA, Tiberius.
1978. On the Objectives and Methodology of National Forest Inventory System In Joint Meetings of IUFRO Groups. International Union of Forest Research Organizations. National Forest Inventory June 18-26, 1978. Bucuresti-Romania. p. XI-XXVIII.

There are three main types of inventory, the operational, the management, and the national forest inventory. All three are concerned with providing estimates about forest resources, the first on current values only, the others on current values and rates of change. The data from operational and management inventories are used to make short and long term plans for the management of specific forest ownerships, those of national inventories are used to set national forest policy, express this policy by appropriate legislation and national programs and finally create the organizational structure to carry out these programs. The main sampling designs currently used by various national forest inventory systems are summarized, and in view of the modern approaches to resource management, several basic principles are being identified. The national inventory should be of the integrated, multiple use type; the field measurements should be made to be independent of current standards of merchantability; for efficiency, the system should consist of successive inventories making use of both permanent and temporary plots; post stratification is to be preferred to pre-stratification; all sources of error must be recognized and accounted for when calculating precision. Finally, several areas where research is needed are identified and international cooperation is strongly advocated.

34 CUNIA, Tiberius.
1978. Short Survey of Worldwide Forest Inventory Methodology.

Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For Serv., U.S.D.A., Fort Collins, CO. p. 114-120.

Discusses separately several classes of sampling methods as applied to forest inventory. The mensurational or data processing aspects of these methods are not covered. The statistical features of the various sampling designs are emphasized.

35 CUNIA, Tiberius. (ed.)
1974. Proceedings: Monitoring Forest Environment Through Successive Sampling. State Univ. of NY, College of Environmental Science and Forestry, Syracuse, NY. 390 p.

This volume contains all but two of the papers presented at the Symposium on "Monitoring Forest Environment Through Successive Sampling," held in Syracuse, New York, June 24-26, 1974, jointly sponsored by the IUFRO Subject Group S4.02 on Forest Resources Inventory, by the SAF Inventory Working Group, and by the SUNY College of Environmental Science and Forestry, Syracuse, New York.

36 CUNIA, Tiberius, and R. B. Chevrou.
1969. Sampling with partial replacement on three or more occasions. Forest Science, 15(2):204-224.

The theory of sampling with partial replacement is extended from two to three or more consecutive measurements of the same forest population. An illustration is given of its application to continuous forest inventory.

37 CURRY, Guy Lee.
1971. Multi-Product Dependent Inventory Models. Ph.D. Thesis. University of Arkansas. 199 p.

This research examines multi-product dependent inventory problems where the cost of replenishing inventory is a constant plus a variable for each product simultaneously ordered. The ordering policy utilized for this type of system is the can-order policy. By utilizing the solution technique presented, the study optimized the total cost equation to obtain the ordering policy. The technique consists of an optimization, simulation and iteration procecure.

A nonparametric approach to a stochastic demand model is developed. The inventory model assumes instantaneous replenishment and no back-orders. The ordering policy is obtained by optimizing the total cost equation using the solution using the solution technique presented. The model is extended to consider a constraint on inventory storage availability.

A model for the multi-product stochastic inventory problems with fixed-delivery lead time, known-period demand distributions, and joint-ordering cost is developed. The dependent ordering policy is obtained by the proposed general iteration procedure.

For all inventory models considered, comparisons are made between the system costs for the dependent ordering policies developed in this research and the traditional method of treating the products independently. Fortran IV programs to solve each of the models were developed and are listed in Appendices B, C, and D.

The problem of obtaining the distribution of the total cost of the system when the parameters of the cost equation are random variables instead of expected values is considered. The approach treats the cost equation as an algebraic function of randum variables and develops the resultant distribution. Resultant distributions are obtained for the product of two general triangular distributions and for the sum of a general uniform distribution with the product of two general uniform distributions.

38 CUSTANCE, N. D. E., M. O'Hagan, and P. P. O. Serle.
1977. Earth Resource Surveys and Their Interpretation - An Introduction. Syst. Technol. 26 (June):9-14.

Man is dependent on the earth's natural resources, and the need to improve his knowledge and understanding of them is increasing. This article is an introduction to the subject of earth resource surveys and the interpretation of imagery derived from satellite or aerial surveys of the earth.

D

01 DAVIS, Lawrence S. and Jan A. Henderson.
1975. Land Classification Systems--The Needs of Land Use Planners. In America's Renewable Resource Potential - 1975: The Turning Point; Proceedings, Soc. of American Foresters. 301-311 p.

From the perspective of land use planners and managers, land classification is a means to obtain information about the land which can help their planning and decision making. We will develop the general requirements of a land classification system by examining the nature and requirements of a suitable wildland information system and from this derive the characteristics of an appropriate classification system.

First we will present a statement of the basic concept, theory and assumptions of information systems. Then we will identify the users of wildland information (the planners and managers) and outline the types of information they need to answer their questions and problems. Finally, we will advance what we feel to be the characteristics of a classification system which will function cost-effectively as part of an information system.

02 DAVIS, Lawrence S. and Jan A. Henderson.
1977. Many Uses and Many Users: Some Desirable Characteristics of a Common Land and Water Classification System. In Classification, Inventory and Analysis of Fish and Wildlife Habitat, Symposium. U.S.D.I., Fish and Wildlife Service. FWS/OBS-78/76 p. 13-34.

The central objective in this paper is to specify the structure of this common framework for classification. First we will examine the different clientele and the uses they make of land and water classification. Next the functional role of classification will be formally established within a model of solving problems in resource management by using a classification-based information system. Given these uses and this functional role of classification, we then review the three basic approaches to classification--component, integration, and regionalization--and present a classification of classification systems. The paper is summarized by listing elements of a common classification framework and recommendations for building efficient systems from this framework.

03 DAVIS, Ronello M.
1976. U.S. Soil Conservation Service. In Proceedings National Wetland Classification and Inventory Workshop, U.S.D.A., For. Serv., Soil Conservation Serv., p. 38-49. (College Park, MD, July 20-23, 1975)

Describes the work the SCS is doing in developing a standard wetland classification system.

04 DE AZEBEDO, L. H. A.
1971. Radar in Amazon, In Internat. Symp. on Remote Sensing of Environment, 7th, Ann Arbor, Mich., 1971, Proc.: Ann Arbor, Mich., Mich. Univ., 3:2303-2306.

In order to provide basic data for planning the development of the Amazon Region, the Government of Brazil has undertaken one of the largest and most concentrated efforts to map natural resources. The survey will employ a Goodyear, synthetic-apture, side-looking airborne radar system, a wide-angle Zeisse camera with color I.R. film and a multiband cameria, mounted in a Caravelle aircraft to image 1,500,000 km^2 (about 1/6 the area of the U.S.) of the Amazon region of Brazil. Brazilian scientists will interpret the imagery and conduct ground truth operations in order to produce maps of the geology, geomorphology, hydrology, vegetative cover, soil types and land use potential of this vast area. These maps will be used to select priority areas for more detailed remote sensing and ground surveys.

05 De GLORIA, S. D., S. J. Daus, and R. W. Thomas.
1975. The Utilization of Remote Sensing Data for a Multi-disciplinary Resource Inventory and Analysis within a Rangeland Environment. Proc. Annu. Meet. Am. Soc. Photogramm. 1975:640-659.

The Bureau of Land Management (BLM) is charged with the multiple-use management of National Resource lands which encompass over 180 million hectares in the eleven western states and Alaska. Due to the vastness of these lands, the BLM realizes the need to integrate remote sensing applications technology into their planning system. Various remote sensing techniques were utilized to produce map products for assessing the applicability of these techniques to the BLM system. Techniques include manual analysis of LANDSAT-1 and high altitude, color-infrared photography, and the application of discriminant analysis and multistage sampling techniques in a human-machine interactive analysis of single-date LANDSAT-1 digital tape data. Manual analysis of single-date LANDSAT-1 imagery provided landscape vegetation resource maps. The high-altitude photography was utilized to produce vegetation-type and "sensitive area" maps for two BLM Planning Units. Acreage and productivity estimates by major vegetation type were generated using multistage estimates from sampling units on LANDSAT-1 digital data, high-altitude photography, very large-scale aerial photography, and systematically collected ground data. The information generated will provide the BLM with timely and cost-effective information regarding the

06 De GLORIA, S. D., S. J. Daus, N. Tosta and K. Bonner.
1975. Utilization of High Altitude Photography and LANDSAT-1 Data for Change Detection and Sensitive Area Analysis. Proc. of the 10th Int. Symp. on Remote Sensing of Environ., Arbor, Mich. Oct. 6-10, 1975. 1:359-368. (See Abstract for 05.)

07 DEMARCHI, Dennis A., and Thomas W. Chamberlain.
1977. The Canadian Experience: An Approach Toward Biophysical Interpretation. In Classification, Inventory and Analysis of Fish and Wildlife Habitat Symposium, U.S.D.I., Fish and Wildlife Service. FWS/OBS - 78/76. p. 145-155.

Fish and wildlife habitat inventory in Canada has evolved from single use capability classifications to biophysical-base data descriptions capable of a variety of resource interpretations. Key aspects of this evaluation have been the design of inventory systems to match our needs, a careful correlation of objectives and inventory scales, and the separation of specific interpretations from the habitat characteristics upon which they are based. Major deficiencies still exist in understanding how fish and wildlife systems interact with other resources, and in creating administrative systems capable of handling these interactions.

08 DEPT. OF NORTHERN SASKATCHEWAN.
1974. Data to be Collected. In Canada's Northlands; Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands, Ecological Land Classification Series No. 0. p. 105-106.

The Department of Northern Saskatchewan, through a contract with the Institute for Northern Studies and Electrical Engineering Department of the University of Saskatchewan, is developing a geographical information storage and retrieval system. The information listed will be included in the system: population, education, health, social assistance, fisheries, etc. . . .

09 DILL, H. W., Jr.
1968. The Role of Airphoto Interpretation in Land Resource Inventory in the Developing Countries, In 34th Ann. Mtg., Am. Soc. Photogramm. Proc. p. 110-113.

This paper discusses the problems of land resource inventory in the developing countries and describes how use of airphoto interpretation is aiding in providing information for planning agricultural development to meet the pressing needs for production of food and fiber.

10 DIRSCHL, H. J.
1974. Project Plan Integrated Landscape Survey of Potential Gas Pipeline Routes on the Arctic Islands and Adjoining Mainland. In Canada's Northlands; Proceedings of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands, Ecological Land Classification Series, No. 0. p. 107-110.

Within the context of the federal government's concerns regarding gas pipeline development in the Arctic, this project aims to produce an integrated landscape classification for those areas of the Arctic Islands and adjacent mainland through which trunk gas pipelines would likely be routed. That mapping system is to be adapted to the special environmental conditions of the Arctic and applicable to various governmental programs, including the interdepartmental pipeline concerns (in parallel to those for the Mackenzie Valley and Northern Yukon), and land management responsibilities of the Department of Indian Affairs and Northern Development, the wildlife management functions of the Canadian Wildlife Service (Environment Canada) and the Northwest Territories, and to northern development in general. The work will be based on the integrated landscape mapping system that is currently being developed according to experience gained in an interdisciplinary pilot study carried out in 1973 on Melville Island. Compatibility with the ecological (biophysical) land classification system will also be sought.

11 DORR, Albert Ernest.
1970. An Empirical Investigation of the Multivariate Multiple Sample Location Problem. Ph.D. Thesis. Univ. of Okla. 72 p.

This dissertation is concerned with the development and evaluation of a multivariate test of location for multiple samples. Various measures of the distances between an observation and the sample mean vectors, used to assign observations to subsets, and procedures for testing the resultant subsets are investigated using Monte Carlo techniques. Difficulties in the use of the subsets are encountered and a continuous statistic, U, is selected for investigation.

Although the results are not conclusive, the data lend some support to the use of the proposed test rather than the MVAOV when there are four treatment groups. The α and β levels for the proposed test appear to be no higher than those for the MVAOV when the assumptions for the MVAOV are met. The observed Type I and Type II error rates for the proposed test are usually slightly lower than those of the MVAOV when the assumptions of normality and homogeneity of dispersion matrices do not hold.

No strong statement is warranted by the data, but there is some indication that the MVAOV is not so robust for four treatment groups as for two.

Further investigation of the distance measure utilized could reveal modifications which would result in a test suitable for two treatment groups and superior to the MVAOV when its assumptions are not met. Despite complexity of the distance measure, which may preclude a mathematical solution, results of the present work seem to warrant continued research on the measure.

12 DRISCOLL, Richard S.
1978. Forest Inventories for National Assessments in the United States. In International Union of Forest Research Inventory. Proceedings from Meeting in Bucuresti-Rumania, p. 629-636.

The Forest inventory of the United States is designed to obtain data on forest area, timber volume, growth, mortality and harvest within limits of specified national sampling errors. The inventories are conducted by Regional Units who also obtain data for certain regional uses. The data are then combined for National reporting on assessments of the Nation's timber situation.

Recent legislation in the United States requires periodic assessment of all the Nation's natural renewable resources. This is being done on the basis of five resource elements: (1) outdoor recreation and wilderness, (2) wildlife and fish, (3) forest-range grazing, (4) timber, and (5) water. Equally important are analyses of multiresource use interactions including cause/effect relationships of resource management decisions. Two major problems need to be solved to assure realistic national and regional assessments. These are: (1) the development of hierarchical classification systems to establish compatible sampling and data bases within and among natural resource agencies, and (2) the development of multiresource inventory procedures which are designed to obtain data on all resource elements simultaneously.

13 DRISCOLL, Richard S.
1973. Land Classification Systems: Moderator's Comments. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 155-156.

Requirements of the classification system are described; objectivity, relative permanence, and perceivability.

14 DRISCOLL, Richard S.
1978. National Assessment Needs. In the Proceedings of the National Symposium on Classification, Inventory, and Analysis of Fish and Wildlife Habitat. FWS/OBS-78/76. U.S. Fish and Wildlife Serv., p. 35-40.

National assessment needs for wildlife and fish habitat are arrayed into five general groups: 1. A Determination of Information Needs: This includes area, extent, geographic location, and structure of vegetation type; kind of substrate within the types to evaluate soils and topography; ecological successional stages of the vegetation; and periodicity of food productivity. 2. Resource Classification: A compatible, among agencies, and ecological classification system is required to mesh data from different sources. 3. Resource Inventory: Compatible resource inventory systems are required so that data are collected similarly, withdrawn from compatible data bases for analyses, and are multifunctional to realistically evaluate and assess interactions. 4. Analytical Procedures: Improved analytical procedures need to be developed so that national assessments are based on habitat quality and quantity as well as output products. 5. Data Management Systems: Compatible information and data management systems are required to provide rapid access to date and information.

15 DRISCOLL, Richard S. and Richard E. Francis.
1975. Range Inventory: Classification of Plant Communities. In Evaluation of ERTS-1 Data for Forest and Rangeland Surveys. U.S.D.A. For. Serv. Res. Pap. PSW-112, 67 pp.

Tests showed data gathered by the first Earth Resources Technology Satellite would be useful to managers of large forest ownerships. Forest and nonforest lands were distinguished with 90-95 percent accuracy. Forest disturbances could be detected with 90 percent accuracy when ERTS data were compared with aerial photos.

16 DRISCOLL, Richard S., D. R. Betters and H. D. Parker.
1978. Land Classification through Remote Sensing - Techniques and Tools. Jour. of Forestry. 76(10):656-660.

Recent developments in techniques for land classification involve the use of electronic and photographic remote sensing systems that provide data by way of both aircraft and earth-orbiting satellites. Multivariate statistical methods are helpful in analyzing information of this type.

17 DRISCOLL, Richard S., John W. Russell and Marvin C. Meier.
1978. Recommended National Land Classification System for Renewable Resources Assessments, Forest Service, U.S.D.A., Inservice Report. 44 p., Xerox.

The objectives of this proposal are: (1) To recommend a classification system that can be implemented immediately with minimum impact on existing resource inventory, evaluation, and assessment activities to provide the framework for future RPA assessments; (2) To assure the recommended classification system takes full advantage of existing data bases; (3) To assure the recommended classification system is compatible for use by other natural resource agencies to assure compatibility of data bases for continuing resource assessments and appraisals.

18 DU, M. Kwen and L. O. House.
1975. Integrated Woodlands Information and Planning System. In Systems Analysis and Forest Resource Management: Proceeding Workshop by SAF, University of Georgia, Athens. p. 427-432.

A Woodlands Information and Planning System (WIPS) is currently under development by Great Northern Paper Company. This system is being created with a global approach to design, and a modular approach to implementation. As currently envisioned, WIPS will be comprised of eight subsystems. An "in place" inventory system, supplemented with preoperation cruising, will generate data to be maintained in a data base and off-line microfiche file. A stand table projection type simulation model will be used to support short and long range L. P. planning models. A capital investment evaluation model will complete this fully integrated system.

19 DUFFY, P. J.
1978. The Application of Ecological Land Classification to Environmental Impact Assessment. In Applications of Ecological (Biophysical) Land Classification in Canada. Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. p. 91-100.

The use of ecological land classification in the environmental impact assessment of Canadian projects is described. Examples are drawn from projects in Newfoundland, Nova Scotia, Quebec, Alberta and the Northwest Territories. Applications of ELC have been limited. However, they confirm the potential usefulness of the system as an organized, efficient, and cost-effective approach

to baseline information garthering for this purpose. The flexibility of map scale and report detail of ELC lends itself to the assembly of generalized information at the early stages of the environmental impact assessment process. As more detail is required on specific sites (e.g. pipeline river crossings) and ecologically sensitive areas (e.g. caribou calving grounds) then larger scale maps and more detailed baseline information can be added within an existing ELC framework.

20 DURRENBERGER, Robert W.
1973. Dictionary of the Environmental Sciences. National Press Books, Palo Alto. 282 p.

The dictionary was prepared to help people concerned with the environment, whether professionals or novices, to bridge the gap between and among the various environmental disciplines so that they can convey their thoughts to one another with clarity and understanding.

21 DYER, A. A.
1974. Multi-Resource Data Systems for Land Use Planning.. In Inventory Design and Analysis, ed. W. E. Frayer, G. B. Hartman, and D. R. Bower, Fort Collins, Colorado. p. 162-169.

Prevailing concept of multi-resource inventories must be expanded beyond compilation of multiple physical resource data. The objective is to illustrate the importance and general process of multi-resource analysis in land-use.

E

01 ECO-CLASS TASK FORCE.
1973. Ecoclass - A Method for Classifying Ecosystems. U.S. Forest Service, Intermtn. For. and Range Exp. Stn. Mimeo:1-52p.

The ECO-CLASS method will provide the necessary framework for forthcoming multiple use planning approaches as well as providing a communication tool for interdisciplinary use in discussion of ecosystems.

02 EEDY, W., K. Schiefer, J. Rowsell and R. McCoy.
1978. Application of Ecological (Biophysical) Land Classification in the Environmental Assessment Process: Examples from Various Types of Resources Developments across Canada. In

Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7; 221-238 p.

Examples from five recent Beak studies are discussed to illustrate the importance of ecological land classification to the environment impact assessment process in Canada. These represent major developments from the Maritimes, Quebec, Ontario, the Prairies and the Arctic. They also include areas described by a varying sophistication of classification, from very little to the most detailed available. Recommendations are made concerning the future preparation, usefulness and avoidance of misuse of ecological (biophysical) land classification.

03 EK, Alan R. and James N. Issos.
1976. Bayesian Estimation Methodology for Forest Inventory. Paper Presented at Midwest Mensurationists Meeting, Sept. Glen Arbor, Mich. 16 p.

Traditional forest sampling efforts draw heavily on prior information on the population of interest for survey design. The resulting estimates, themselves however, ignore the presence of prior information. Another approach with more intuitive appeal is the use of Bayesian methodology. Bayesian methodology allows traditional approaches but also incorporates prior knowledge into the estimate. The approach involves direct weighting of prior information on the variable of interest and the sample estimate. This paper describes the approach and computer programs for its implementation. Several kinds of prior information (including type averages and subjectively located plots) are then considered as means for increasing the precision of estimates in stand description. Analyses of confidence interval widths for estimates of stand basal area for several forest types in northern Wisconsin indicate substantial gains in precision for Bayesian procedures over simple random sampling for small sample sizes. Applications to other types of inventory and sampling efforts are also discussed.

04 EK, Alan R. and James N. Issos.
1978. Bayesian Theory and Multi-Resource Inventory. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For Serv., U.S.D.A., Fort Collins, CO. p. 291-298.

Bayesian concepts and estimation procedures are reviewed as a supplement to sampling theory approaches to inventory. Emphasis is placed on the identification of useful prior information. The

relationship between stratification and the gains possible from Bayesian approaches using past surveys for prior information are discussed. Results from empirical comparisons of Bayesian and sampling theory approaches to basal area and type area estimation are also presented.

05 ELLIS, Grant.
1978. Taking Inventory. Forestalk, Fall '78. p. 11-15.

There are 52 million hectares (130 million acres) of forest land in British Columbia, but how many of these contain mature timber? What is the growth rate of immature timber? How healthy are the forests?

To try to answer these and countless other questions about the B.C. forest resource, the Forest Service has spent over 60 years developing progressively more detailed and accurate forest inventory procedures. Today, with the assistance of space age technology, the Ministry of Forests Inventory Division is in the process of mapping and cataloguing B.C.'s forests with greater precision than ever before.

06 ENGELMAN, M. D.
1966. Energetics, Terrestrial Field Studies, and Animal Productivity. Advances Ecol. Res. 3:73-115.

The goal of this paper is to evaluate the growth and development of terrestrial energetics at this point in its history. The task is by no means a small one. Even though the accumulated literature at present is rather limited, the studies that have been reported are recorded in many different journals covering diverse approaches to ecological research. In this article, the subject of field estimation of productivity will be approached in three ways: first, the historical and theoretical bases which undergird terrestrial productivity studies will be considered; second, the various works in the field will be reviewed, with particular emphasis upon the relationships of the papers to one another and the type of data each yields; finally, the progress of terrestrial energetic studies as a whole will be evaluated and areas wherein critical research is needed will be indicated.

07 ENSLIN, W. R., S. E. Tilman, R. Hill-Rowley, and R. H. Rogers.
1977. A Procedure for Merging Land Cover/Use Data from Landsat, Aerial Photography, and Map Sources: Compatibility, Accuracy, and Cost. American Society of Photogrammetry Convention, 43rd Annual Meeting, Feb. 27 to Mar. 5, 1977. Washington, D. C., pp. 449-458.

Regional planning agencies are currently expressing a need for detailed land cover/use information to effectively meet the requirements of various federal programs. Individual data sources have advantages and limitations in fulfilling this need, both in terms of time/cost and technological capability. A methodology has been developed to merge land cover/use data from LANDSAT, aerial photography and map sources to maximize the effective use of a variety of data sources in the provision of an integrated information system for regional analysis.

A test of the proposed inventory method is currently under way in four central Michigan townships. This test will evaluate the compatibility, accuracy and cost of the integrated method with reference to inventories developed from a single data source, and determine both the technological feasibility and analytical potential of such a system.

08 ERB, D. K., and P. Eng.
1968. Geomorphology of Jamaica: Photogramm. Eng. 34(11):1148-1160.

The application of the technique of aerial photograph interpretation to geomorphological investigations in Jamaica is discussed. Jamaica was selected because of its variable geologic foundation, its basically humid-tropical climatic regime, and the availability of supplementary data. Three different approaches to the study are reviewed: primary reconnaissance to develop the overall picture and to delineate major landform regions; regional analysis to determine the characteristics of forms, general processes, and chronology of these units; and detailed analysis of specific forms, specific processes, or anomalous features irrespective of their place in the regional picture. Some of the advantages and limitations of the photo-interpretive technique as applied to this field of investigation are mentioned.

09 ERICSON, W. A.
1965. Optimum Stratified Sampling Using Prior Information.
J. Amer. Statis. Assoc. 60:750-751.

The question of how the well-known Neyman stratified allocation result generalized when it is formally assumed that there is prior information concerning the unknown stratum means is dealt with here. This prior information is taken to be expressible in the form of a multi-variate normal prior distribution. Several methods of assessing prior distributions are discussed. The allocation for stratified sampling is shown to be a special case of a more general allocation problem. A computational algorithm is presented for this more

general problem of finding the allocation of sampling effort which minimizes the posterior variance of any given linear combination of unknown normal process means subject to a budget constraint. A feature of the solution is that for limited budgets one may rely on his prior information concerning some strata, sampling only in a subset of the strata. Finally, several applications are briefly described including a "non-Bayesian" solution to a particular problem of the allocation for a multipurpose stratified sample.

F

01 FAGUNDES, P. M.
1974. The RADAM Project--Radargrammetry of the Amazon: Bildmessung und Luftbildwesen, 42:47-52.

Construction and function of the SDC Multispectral Viewer Model 62 are explained. The concept of that instrument is based on the principle of primary color addition (blue, green, red), hence it is possible to get colour and/or false colour renditions if suitable film-filter-combinations are chosen. Some examples of interpretation demonstrate the advantages of this rather simple multispectral technique.

02 FAO.
1971. Use of Skylab Data for FAO Integrated Resource Surveys: Rome, FAO, AG:Misc/71/4.

03 FAO.
1973. Use of ERTS-B (Landsat-2) Imagery for FAO Integrated Resource Surveys: Rome, FAO, AGS:Misc/73/20.

04 FAO.
1974. Report on the Second FAO/SIDA Training Course on Forest Inventory. (Ibadan, Nigeria Sept.) Rome. 291 p.

The Training Course included lectures on the principles and techniques of forest inventory supported by office and field exercises, case studies of completed and ongoing forest inventories, and a three-day study tour. Lectures were devoted mainly to the following topics: objectives and planning of forest inventories, sampling techniques, photointerpretation and remote sensing techniques, forest mensuration, forest inventory designs, computer programming and data processing in relation to forest inventory.

In addition to the indicative inventory of reserved high forest presently carried out in Nigeria within the UNDP/FAO/Nigeria High Forest Development Project, which was demonstrated in the field, examples of other large-scale forest inventories performed in Africa were described, such as the National Forest Inventory of Liberia and inventories recently carried out in some French-speaking African countries. A three-day study tour in the middle of the course included visits to the ECA[2] Regional Centre for Training in Aerial Surveys in Ile-Ife, the wood industry complex of the ATP[3] in Sapele, and the silvicultural experiments in the Sapoba Forest Reserve.

05 FFOLLIOTT, Peter F.
1978. A Multifunctional Inventory Approach to Multiple Use Analysis. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p.395-402.

To insure that land management practices do not adversely affect the environmenal complex, direct measurement of all natural resource products and uses is desired. However, when direct measurements are not possible, a multifunctional inventory can be synthesized for multiple use evaluations using pertinent research findings. To choose the best land management practice from a number of alternatives, it is necessary to know the present and future natural resource products and uses, the direct benefits and costs, and the suitability of a tract of land. Care must be exercised when selecting the research findings that will be used to make indirect estimates.

06 FFOLLIOTT, Peter F. and David P. Worley.
1965. An Inventory System for Multiple Use Evaluations. U.S. For. Serv. Res. Pap. RM 17, 15 pp.

Describes a multiple BAF (basal area factor) inventory system flexible enough to describe a forested tract so multiple use interpretations can be made from known relations of product yields to the inventory description of the resources on the tract. Basal area was selected as the inventory basis because it is (1) easily determined in the field; (2) easily converted to other expressions; and (3) many multiple use relations have already been developed with basal area as the independent variable. A multiple BAF system is a point-sampling system that uses several basal area factors to describe the stocking of trees. Its use is illustrated by hypothesizing forest management methods for a pilot watershed in Arizona.

07 FINDLAY, B. F.
1978. Meteorological Services for Ecological Land Classification. In Applications of Ecological (Biophysical) Land Classification in Canada: Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification. (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. 101-114p.

A review is made of the facilities offered by the national meteorological observing network. Recent climatological studies which have pertinence to ecological (biophysical) land classification are reviewed by theme and according to whether they treat broad or small discrete areas, since the analysis techniques vary above and below the 1:2,000,000 scale. User response to these studies is cited in general. It is contended that most problems result from inadequate communications between client and contractor as to purpose and content of the specific study.

08 FINLEY, Virginia P.
1960. Photo-Interpretation of Vegetation. U.S. Army Snow Ice and Permafrost Research Estab. Corps of Engineers, Wilmette, Ill. Technical Report 69, 36 p.

The results of a literature survey on the applicability, capabilities, and limitations of existing airphoto interpretation techniques in determining certain physical properties of vegetation are reported. The interpretation of tree and scrub stands is emphasized, with special attention given to measurements of trunk diameter and spacing, canopy height and coverage, density and height of undergrowth, and type of foliage. The accuracy of measurements are examined with respect to scale, photo characteristics, seasonal effects, and light conditions. Photographic factors affecting vegetation images, vegetation characteristics obtainable from aerial photographs, and vegetation identification and its significance as an indication of terrain conditions are discussed. The appendices contain information relative to type of photography, instrumentation, species identification, physical characteristics of vegetation, and vegetative keys used in the various literature sources studied.

09 FLICK, A. Warren.
1975. A Solution to the Value Problem of Multiple-use Planning. In Systems Analysis and Forest Resources Management; Proceedings Workshop by SAF, University of Georgia, Athens, p. 79-86.

Input-output analysis applied to a forest system provides prices of all major forest outputs. These prices can then be used in

the objective function of a mathematical program which can be solved to find the output mix that maximizes the value of forest production. The prices are appropriate because they reflect public decisions.

10 FOSTER, K. E., P. F. Mackey and C. D. Bonham.
1972. Natural Resource Inventory for Urban Planning Utilizing Remote Sensing. Univ. of Ariz., Office of Arid Land Studies, Tucson, AZ, OALS Bull. 3, 18 p.

Remote sensing techniques were applied to the lower Pantano Wash area to acquire data for planning an ecological balance between the expanding Tucson metropolitan area and its environment. The types and distribution of vegetation are discussed along with the hydrologic aspects of the Wash.

11 FOWLER, Gary W. and Carl F. Davis.
1979. Sampling Natural Resource Populations: Mutually Exclusive Fixed-Area Sampling Units. U.S.D.I. Bur. Land Mgmt. Resource Inventory Notes BLM 23 p. 1-7.

The two conceptual populations of sampling units formed by dividing a physical population into a finite number of mutually exclusive (non-overlapping) fixed-area square and circular plots, respectively, were compared by examining three completely enumerated forest populations. The conceptual population of circular plots yielded a biased representation of each of the forest populations. The bias is unpredictable and depends on the spatial and size distribution and density of trees. Forest size and plot size appear to have little effect on the bias. The natural resource sampler should be aware that the bias is large for irregular forests and negligible for homogeneous forests.

12 FOWLER, Gary W. and Dale Hauke.
1979. A Distribution-Free Method for Interval Estimation and Sample Size Determination. U.S.D.I. Bur. Land Mgmt. Resource Inventory Notes BLM 19 p. 1-8.

A distribution-free method for interval estimation and sample size determination based on Tchebysheff's Inequality is presented and compared with the normal-based confidence interval methods currently used in natural resource sampling. The distribution-free method appears to be superior to the normal-based methods.

13 FOWLER, Gary W. and William G. O'Regan.
1974. One-sided Truncated Sequential t-test: Application to Natural Resource Sampling. U.S.D.A., For. Serv. Res. Pap. PSW-100, 17 pp.

A new procedure for constructing one-sided truncated sequential t-tests and it application to natural resource sampling are described. Monte Carlo procedures were used to develop a series of one-sided truncated sequential t-tests and the associated approximations to the operating characteristic and average sample number functions. Different truncation points and decision boundary patterns were examined. The fixed sample size t-test and Barnard's open one-sided sequential t-test were compared with the new procedure. The upper one-sided test described can easily be modified to a lower one-sided test.

14 FRAYER, Warren E.
1978. Objectives of Multi-resource Inventories in Relation to Design Considerations. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. For. and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 267-269.

Resource inventories must be tailored to end objectives; conduct of an inventory satisfies only a set of intermediate objectives. The types of decisions to be made and kinds of information needed as input to decision making must be specified prior to design of an inventory. Intermediate objectives to be satisfied by the inventory process must be cast in terms leading directly to design criteria.

15 FRAYER, Warren E. and George M. Furnival.
1967. Area change estimates from sampling with partial replacement. Forest Science, 13(1):72-77.

Presented is a method of calculating changes in area attributes on remeasured plots. Methods are shown whereby the estimates of change can be applied to results of a previous inventory and combined with the results of a current inventory to form final estimates of current parameters. An example is shown based on data taken from the most recent forest survey of Vermont.

16 FRAYER, Warren E., George B. Hartman and David R. Bower.
1974. Inventory Design and Analysis. Proceedings of a Workshop Sponsored by the Inventory Working Group, Society of American Foresters, Washington, D. C. 368 p.

A summary of the proceedings of the workshop held in 1974. Covers everything from setting objectives of the manager, through the different inventories used to meet these objectives. Covers, in detail, different inventory methods and "pro's and con's" of each.

17 FRAYER, Warren E., L. S. Davis and Paul G. Risser.
1978. Use of Land Classification. Jour. of Forestry. 76(10):647-649.

Land classification serves three basic purposes. The first two--developing information needed for policy formulation and for land management--differ mainly in the amount of information required. A single, hierarchical classification system may serve both purposes equally well, although the techniques employed in applying the system may differ. A third purpose--coordination within and between land-managing agencies--provides a strong argument for standardized classification.

18 FRIEND, A.
1978. Ecological Mapping and Socioeconomic Statistics. In Applications of Ecological (Biophysical) Land Classification in Canada: Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. 115-126 p.

The paper describes Statistics Canada's approach to the development of a comprehensive framework for environment statistics. Efforts to modify the National Accounts to obtain net social benefit estimates are discussed with particular emphasis on the conceptual limitation of introducing environmental damage costs estimates. Alternative approaches based on material-energy balances and statistical frameworks of the "stress-response" interface of human activity and the environment are examined. The development of the latter system is in response to the growing awareness of the inadequacy of a framework based on traditional categories of water, air, land, etc. The integration of socio-economic statistics with biophysical data is emphasized. The final section of the paper identifies the major stressors on the environment where socioeconomic data describe at a macrolevel the human activities and monitoring records providing the indicators of the state, and change of state, of the environment.

19 FULTON, R. J., et al.
1974. Terrain Mapping in Northern Environments. In Canada's Northlands; Proceedings of a Technical Workshop--To Develop an

Integrated Approach to Base Data Inventories for Canada's Northlands (April 74) Ecological Land Classkfication Series No. 0. p. 3-22.

A terrain analysis should provide three general things: 1) a description of the static land surface and the materials underlying it; 2) an analysis of the processes currently acting on the landform materials; and 3) a presentation of the Quaternary history. Once the information required for these prime items is in hand, it is possible to go one step further and predict how the area in question will react under any use.

To arrive at the three general items of the final analysis, specific information must be obtained relating to: 1) properties and conditions of surface materials; 2) geomorphology; 3) spatial relationships of surface materials; 4) processes; and 5) the historical context. Each of these is itself made up of several sub-items of information that are listed in Table I and further described below.

20 FURNIVAL, George M.
1976. Fundamental Operations in Data Management. Proceedings: Resource Data Management Symposium. Soc. Am. For., August, Purdue University, West Lafayette, Indiana, 24-33 p.

The fundamental unit of organized data is an association or relation which records how one type of data is related to another. The object of all data processing is to convert or derive new associations from sone already existing. In other words, given some existing files or tables, the name of the game is to construct a new file or table. The basic operations here are the combining and collapsing of files.

We have attempted to describe some of the more common structures and procedures employed in data processing. We have also attempted to show that many of the procedures and structures are related--one blending into another, one reflecting another.

G

01 GARDINER, M. J., M. Walsh and J. Lee.
1973. Studying Leitrim's Problems--First Part of a Resource Survey. Farm Food Res. 4(6):126-127.

02 GARMAN, M. B.
1976. Multi-Product Economic Order Quantity Analysis Under Minimum Valuation Constraints. Operational Research Quarterly. 27(4):983-989.

The economic order quantity method is examined in the context of a required minimum valuation of a multi-product inventory. Such a context may arise when inventories are pledged to secure a loan. Two cases are developed according to the contractual nature of the minimum valuation requirement, and computational procedures are provided for each case. Implicit costs and loan interest rates attributable to valuation guarantees are examined via two examples. A management tool, the "Cover-v rule," emerges as a useful concept for allocating required buffer stocks and for estimating the maximum marginal loan interest rates attributable to valuation guarantees.

03 GATES, William A., Brent H. McCown, and Kent S. Butler.
1977. A Resource Data Management System, GRASP: Bitplane Data Organization. RF Monograph 76-12, IES Report 89, University of Wisconsin, Madison. 17 p.

Bitplane or attribute-plane grids are the operands in the logical and arithmetic expressions used in the GRASP resource data and storage system. The GRASP system was designed to operate in an interactive environment, taking full advantage of feedback and data organization to perform data entry, correction, and manipulation. The capabilities are enhanced by a multiple-file approach that ensures the integrity of the user's data and provides a useful mechanism for managing the various research problems being treated. The construction of suitability and environmental indices is an example of an application area.

04 GATES, William A., Brent H. McCown, and Kent S. Butler.
1977. A Resource Data Management System, GRASP. Description and Documentation of Software. RF Monograph 76-13, IES Report 90, University of Wisconsin, Madison, 179 p.

The development, special features, and software of GRASP (Geographical Resource Analysis Software Package) are described and illustrated, with emphasis on the language of GRASP and the rationale for GRASP's structure and attendant data base support facilities. GRASP is a grid system designed to be used in an interactive computing environment to assure feedback and quick response to information needs. It is a vertically complete system that offers the user a sophisticated array of capabilities, ranging from data entry and modeling to graphics terminal or plotter display.

05 GEIS, James W.
1974. Patterns and Variability in Plant Communities. In Monitoring Forest Environment through Successive Sampling, June 1974. State University of New York, College of Environmental Science and Forestry. p. 177-186.

Plant communities, including forests, are homogenous only in the table of mean values presented by some purposeful investigator. Their composition varies continuously across complex environmental gradients, in relation to successional time, with respect to the interactions of varying populations within component species, and in response to past and present-day floristic influences. The degree of internal community variation and pattern is frequently more profound yet less clearly resolved than that which occurs between communities. Many patterns and their attendant process sets can only be resolved by intensive, prolonged evaluation using permanent inventory techniques.

06 GETTER, James R. and Tom H. Creighton.
1977. Forest Site Index Mapping and Field Model Inputs to Determine Potential Site Productivity. Resource Inventory Notes, BLM 7, U.S.D.I. BLM, Denver, CO. p. 1-10.

This report describes the initial steps, data sources, results, and conclusions from a prototype computer system to overlay multi-variate map and remote sensing data to estimate forest site productivity.

07 GIALDINI, M., S. Titus, J. Nichols and R. Thomas.
1975. The Integration of Manual and Automatic Image Analysis Techniques with Supporting Ground Data in a Multistage Sampling Framework for Timber Resource Inventories: Three Examples. In Proc. NASA Earch Resources Survey Symp. 1 (I-B):1377-1387.

An approach to information acquisition is discussed in the context of meeting user-specified needs in a cost-effective, timely manner through the use of remote sensing data, ground data, and multistage sampling techniques. The roles of both LANDSAT imagery (2 examples) and Skylab Photography (1 example) are discussed as first stages of three separate multistage timber inventory systems and results are given for each system. Emphasis is placed on accuracy and meeting user needs.

08 GIMBARZEVSKY, Philip.
1976. Integrated Survey of Biophysical Resources in National Parks for Manage. Inst. Environ. Can. 14 p.

09 GIMBARZEVSKY, Philip.
1977. L'Anse Aux Meadows National Historic Park, Integrated Survey of Biophysical Resources. Canada Forest Mgmt. Inst. Inf. Rept. FMR-X-99. 113 p.

The main environmental components of L'Anse aux Meadows National Historic Park are mapped at the scale of 1:10,000 and described in the context of land, vegetation, and water resources. The land resources are presented as land types, or ecologically significant segments of the landscape delineated on the bases of their physical properties: bedrock geology, geomorphological origin, soil texture, moisture conditions and local topography. The vegetation resources are mapped as biotic components of land types and classified as three marginal forest types and 20 non-forest plant communities. The evaluation of water resources includes inventory of inland lakes, ponds and streams, listed by drainage systems, and a description of marine elements - classification of coastline and offshore features.

10 GIMBARZEVSKY, Philip.
1978. Land Classification as a Base for Integrated of Renewable Resources Inventories. Integrated Inventories of Renewable Resources. Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 169-177.

The biophysical land classification system presently used in Canada, is an integrated approach to environmental inventory, based on the recognition of landscape characteristics as an ecological framework for the evaluation of natural resources. Development of this system, its hierarchical structure and application in current surveys is described and illustrated with selected examples.

11 GIMBARZEVSKY, Philip.
1978. Structuring of Land Systems with the Aid of the System 2000. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. 263-266 p.

Computer assisted structuring of land systems has been found to be a highly useful approach to manipulation of ecological inventory data. Use of the System 2000 (S2K) permitted definition of

simple, compound and complex land systems in a study of 2036 land units with field information comprising geomorphic origin, soils, drainage conditions, bedrock, aspect, elevation and topography for the 5000 km^2 area of Nahanni National Park, Yukon Territory.

12 GLASCOCK, H. R., Jr.
1978. Need for Integrating Inventories: Moderator's Comments. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO p. 134-135.

Discusses the need for a broad and variable inventory source. Every agency has different needs but is it possible to use one system to meet many needs?

13 GOYAL, S. K.
1978. Note on Multi-Product Inventory Situations with One Restriction. Jour. of the Operational Research Soc. 29(3)269-271.

Demonstrates the possibility to reduce the total requirement of the resource by considering products belonging to more than one group.

14 GREGORY, Robert P.
1978. Integrated Inventories in the Tennessee Valley Region. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 412-419.

The Tennessee Valley Authority currently uses several methodologies for integrated inventory and analysis of terrestrial and aquatic natural resources. Four of particular interest to forest resource specialists are the Woodland Resource Analysis Program (WRAP), the environmental assessment survey, the land analysis system, and the forest and wildland resources inventory. This last method is the one in longest application. It has been used to assess small forest properties as well as forests of the entire region. The method is basically a continuous forest inventory that has been amplified by a number of supplemental surveys.

15 GRELEN, Harold E. and Clifford E. Lewis.
1978. Multi-Resource Inventories: A Potential of the Forest Survey. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv. U.S.D.A., Fort Collins, CO. p. 425-429.

Cooperative efforts by range, wildlife habitat, and other forest resource specialists have led to inventories of renewable resources besides timber in the Forest Surveys in the South. This paper describes the methodology of these inventories.

16 GROSENBAUGH, L. R.
1979. 3 P - Sampling Theory, Examples and Rationale. Technical Note 331, U.S.D.I., BLM Denver, CO 18 p.

The distributions of all possible sample estimates of a specified 10-tree population sampled by each of a wide variety of designs are analyzed to obtain expected mean squared error and bias. Different designs may employ equal or unequal selection probabilities, sample replacement or no sample replacement, fixed number of samples or variable number of samples (and in the last case, N = 0 may require a zero estimate or else resampling). The designs requiring an a priori list include direct, ratio, and PPS samples, while the nonlist designs include several types of 3P samples. A 110-tree population is specified to illustrate the effect of using probabilities that are variously correlated with the variable of interest, and a single sample drawn from the same population (clustered in a specified manner) is used to illustrate point-3P sampling. The 110-tree population is again used in another example to exemplify the generally beneficial effects of frequency-balancing on adjusted 3P sample estimates.

17 GUPTA, R. K., and Abichandani, C. T.
1968. Air-Photo Analysis of Plant Communities in Relation to Edaphic Factors in the Arid Zone of Western Rajasthan: Tropical Ecology, Proc., (1):57-66.

18 GUPTA, R. K. and S. K. Saxena.
1971. Integrated Ecological Surveys for Agricultural Development in the Arid Zones of India. Ann. Arid Zone 10(2/3):85-98.

Six agro-ecological zones based on the land use capability and other ecological features have been delineated for proper utilization of land in Chohtan community development block of Barmer district. Class I and class II lands for intensive agriculture are not present in the block. Class III land comprising the interdunal land or slightly hummocky area may be put under cultivation occasionally with new technology of agriculture. A major part of interdunal plains, classified under class IV

land, may be put under crops with new technology of dryland agriculture. Depressional areas are classified under class V land which are usually unsuitable for crop cultivation and may be used for pasture development. Class VI and class VII lands are occupied by steep sand dunes where there is severe wind erosion. These areas are considered suitable for forestry and pasture development. The rocky bare areas and saline depressions of the part of rann of Kutch classed as VIII land need protection of the natural vegetation. Vegetation types and pasture communities in each landform studied have been described in detail showing the potential for pastoral development and afforestation. Plants for afforestation, soil conservation, orchard development, fodder and other uses which could be cultivated with different water quality in various agro-ecological zones are recommended.

H

01 HAMILTON, David A., Jr.
1978. Specifying Precision in Natural Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 276-281.

The cost of incorrect decision should play an important role in establishing inventory precision. A procedure that minimizes sum of costs of obtaining information plus expectations of loss is described. It is demonstrated that, contrary to common practice optimal precision cannot be specified independently of sampling design.

02 HAMILTON, Thomas E.
1978. National Integrated Inventories-Is What You Need What You Do? Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 136-139.

The need for inventory integration is to describe resource and resource use interactions. Our approach should be to design a program which incorporates what we now know and which allows the flexibility to add new techniques as they become available.

03 HAMNER, Larry N.
1975. WARP. A Multiple Resource Model for Allocation of Wildland Resources. In Systems Analysis and Forest Resource Management, Proceedings Workshop by Soc. Am. For., Univ. of Georgia, Athens, p.127-131.

This paper describes a system developed by the Tennessee Valley Authority to assist private landowners in managing their woodlands. This system constructs a timber harvesting schedule which will produce a number of multiple-use benefits. A computer printout is produced that includes a management plan and harvesting schedule based specifically on the landowner's objectives, consistent with the resource potential of his property.

04 HANIF, M.
1977. On Optimal Level of Clustering for Multi-purpose Sample Surveys in Libya. 41st Session of the International Statistical Institute, New Delhi, India. 5-14 Dec.

05 HANSON, Russell E.
1979. Preparation of Maps for Manual Digitizing, U.S.D.I. Bur. Land Mgmt. Resource Inventory Notes. BLM 22 p. 1-8.

This paper describes some basic concepts and methods in preparing maps for entry into automated information systems. Data entry through manual digitizing methods is assumed.

06 HARALICK, R. M.
1973. Glossary and Index to Remotely Sensed Image Pattern Recognition Concepts. Pattern Recognition 5(4):391-403.

The purpose of the glossary is to state in the simplest possible way the general meaning or word usage for many of the terms in image pattern recognition. There is no intent to provide definitive statements for terms such as "resolution" but rather only statements about the general nature of what resolution is. There is no intent to provide mathematical formulas involving integrals or derivatives in any of the statements. The glossary is designed to be read by those generally unfamiliar with the area and provide for them an overall perspective.

07 HARDING, Roger A.
1973. GRIDS and DNR. Symp. on Remote Sensing Proc. Sioux Falls, SD, p. 398-412. Pub. by Am. Soc. of Photogramm. Falls Church, VA.

The Gridded Resource Inventory Data System (GRIDS) consists of a one-acre sample of each ten acres of land managed by the Department of Natural Resources through the State of Washington 300,333 (sample) data points for 3,000,000 acres. The large array of data collected on these sample points from aerial photographs, maps, field measurements, field activities or any valid source. These data are coded and stored on electronic data processing files for quick retrieval in a variety of listings and computer printout maps. Changes to the data are made quickly and easily thereby allowing for up-to-date, accurate information on the variety of Department-managed lands upon which the resources are changed by a multitude of activities. 13 refs.

08 HARDING, Roger A.
1973. Grid Works for DNR. DNR Report #25, State of Washington, Department of Natural Resources. (See Abstract 08 above.)

09 HARDING, Roger A. and Robert B. Scott.
1978. Phase II Forest Inventory with LANDSAT - Washington Productivity Study. Wash. Dept. of Nat. Res., Div. Tech. Srv. 221 p.

This report describes a demonstration project which used Landsat digital data as one segment of a multistage sampling plan designed to produce typical forest inventory information for each of the five ownership classes in Western Washington. Procedures were developed for direct use of the digital data in computer classification and stratification of three test areas in southwest Washington. Analysis of the three test areas also yielded the optimal size and number of sample plots to be photo interpreted and ground surveyed (the other two segments of the multistage sampling plan).

The procedures developed in the test areas were then applied to an actual inventory of the forests of Western Washington. This involved imposing non-imaged data such as county boundaries and ownership on a data base developed from a combination of Landsat data, aerial photographs, and ground samples. Statistically qualified results are expressed for each ownership. Output form is tabular for basal area, volume, and number of stems. Color-coded maps (not in this volume) at a scale of 1:250,000 supplement the tabular data.

This report represents the extensive evaluation and documentation required of the cooperating parties (Department of Natural Resources, NASA-Ames, Department of the Interior-EROS, and Electromagnetic Systems Laboratories, Inc.).

10 HARDY, Ernest E. and Linda E. Hunt.
1975. Testing Low Cost Interpretation Systems for Updating Land Use Inventories. Proc. of the Int. Symp. on Remote Sensing of Environ. 10th Ann Arbor, Mich. Oct 6-10, 1975 Pub. by Environ. Res. Inst. of Mich. Ctr. for Remote Sensing Inf. and Anal., Ann Arbor, Mich. 1:393-400.

The paper discusses a study designed to test the feaxibility of approaches to developing the re-survey techniques for the New York State Land Use and Natural Resource Inventory. Processes tested included: use of the zoom stereoscope, use of orthophoto base maps, use of high altitude imagery, color photography, and regular black and white photography. Microfiche readers also have been adapted to this work. The most efficient systems are reported, with current results showing the microfiche reader, using high altitude monoptical coverage, as the most efficient and most accurate techniques for interpretation. Cost evaluation is considered in detail, to determine the cost effectiveness of the selected methods.

11 HARDY, Ernest E., Elmer S. Phillips and James E. Skaley.
1973. Evaluation of ERTS-1 Imagery for Land Use/Resource Inventory Information. ERTS-1 Symp., Wash., D. C., Dec. 10-14. 491-496.

The possibility of developing a low cost, manual technique for enhancing ERTS-1 imagery and preparing it in a format suitable for users with wide and varied interests related to land use and natural resources information was investigated. The end product would also have to be compatible with existing information systems. The photo enhancement techniques that satisfied these criteria are described. New classification systems were developed based on the capability of the photographically enhanced ERTS-1 imagery.

12 HARTGRAVES, Charles R.
1977. Federal Land Management Planning: Interrelationships with State and Local Planning. Soil Conservation Society of America Nat'l. Symp. Omaha, Neb. Mar. 21-24, 1977, 392-398.

A new era in resource planning and management has revolutionized relations of the public with U.S.G.S. The Service's planning principles, its enthusiasm for the Nat'l. Forest Management Act, and its embracing of public participation at all levels are described. Preparations also are under way for the 1980 assessment of the National Forest Renewable Resources: This evaluation will be a substantial improvement over the first effort in March 1976.

13 HAUG, P. T. and G. M. Van Dyne.
1979. A Conceptual Model for an Integrated Environmental Analysis on Oil Shale Tract C-b. Proceedings, Oil Shale Symposium Sampling, Analysis and Quality Assurance. March 1979. EPA, Denver,CO. 18 p.

In accordance with lease stipulations requiring that system interrelationships be addressed in the environmental baseline program, a conceptual model of the oil shale Tract C-b ecosystem was developed around 2.5 years of hydrological, meteorological, and ecological baseline data. A systematic procedure was used to organize, classify, summarize, integrate, and synthesize the baseline data into categories of key ecosystem components and processes. The operator's detailed development plans for the oil shale were used to identify anticipated perturbations to the ecosystem. These perturbations were integrated into the conceptual model along with the key components and processes.

14 HAY, George Alan.
1969. Production, Price and Inventory Theory: An Integrated Model of Firm Behavior. Ph.D. Thesis Northwestern Univ. 121 p.

This dissertation is a study in the economic theory of the firm. By making the assumption that firms attempt to maximize the expected value of profits, we are able to derive empirically testable hypotheses regarding the principle determinants of firms' decisions on production, price, and finished goods inventory.

The analysis is based on the model of a firm in an imperfectly competitive environment which is assumed to control the rates of production and shipments, the level of finished goods inventories, the backlog of unfilled orders and price. Demand is assumed to depend partly on price but partly on a random factor which causes the entire demand curve to shift over time.

15 HAZARD, John W.
1969. Optimal Replacement Strategy for Successive Forest Surveys with Multiple Objectives. Ph.D. Dissertation. Iowa State Univ., Ames. Diss. Abst. 30:2486B.

In this paper, convex mathematical programing is adapted to sampling with partial replacement to determine the joint-optimum replacement policy. Cost functions are developed to relate total cost to the subsets of sample sizes. Expressions are derived for new estimators for particular variables of interest. The technique is then applied to optimally satisfy selected Forest Survey objectives.

The statistical properties of new estimators, along with existing estimators, are studied by Monte Carlo sampling of specific forest populations. The objective was to determine how the efficiency of alternative estimators for several variables of interest compare over a range of replacement policies and for two different population conditions. Also, the statistical properties of estimators of population subclass parameters were investigated under a range of replacement policies. The optimum solutions from the convex programing problems were inputs to the Monte Carlo trials for population and subclass estimation.

16 HAZARD, John W.
1974. Optimization in Multi-Resource Inventories. In Inventory Design and Analysis. Proc., Workshop Sponsored by the Inventory Working Group, Soc. of American foresters; Colo. State Univ., pp. 170-177.

The optimum allocation of effort in multi-resource inventories is discussed. Some applications of optimization techniques are reviewed.

17 HAZARD, John W. and Larry E. Stewart.
1974. Planning and Processing Multistage Samples with a Computer Program. U.S.D.A. For. Serv. Tech. Rep. PNW-11.

A computer program was written to handle multistage sampling designs in insect populations. It is, however, general enough to be used for any population where the number of stages does not exceed three. The program handles three types of sampling situations, all of which assume equal probability sampling. Option 1 takes estimates of sample variances, costs, and either a specified cost or precision and computes the optimum number of sampling units to select prior to sampling. Option 2 takes the observations, continuous or discrete, from a pilot survey or actual inventory and estimates the mean and variances. It then computes an estimate of the optimum number of units which should have been taken. Option 3 is a special case of the situation in Option 2 where some of the observations are lost or for some other reason an unequal number of subunits per primary unit exists.

18 HAZARD, John W. and Lawrence C. Promnitz.
1974. Design of Successive Forest Inventories: Optimization by Convex Mathematical Programing. Forest Science 20(2):117-127.

Convex mathematical programing is proposed as a method of optimally allocating forest inventory sampling resources under different sampling plans to meet specified precision requirements on several variables. Results of a sensitivity analysis under sampling with partial replacement shows the response of the solution to changing inputs when each restriction becomes limiting. The solutions illustrate that the optimum replacement fraction can vary from complete remeasurement to large replacement fractions depending upon the specified precision levels, the population parameters, and the relative costs of obtaining information.

19 HE[illegible]FERNAN, Patrick H. and Ruthann Corwin (eds).
1975. Environmental Impact Assessment. Freeman, Cooper and Co., San Francisco, CA. 277 p.

Covers impact assessment-origin, operation and outlook; environmental science-perspective and methods; assessing social and economic impacts, the law of environmental impact assessment, how to prepare an EIS, making the process work and tools for EIS.

20 HEGG, Karl M.
1978. An Evaluation of Small-Scale Color Infrared Photography for Integrated Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 238-241.

The Resources Evaluation Unit at Juneau, Alaska recently completed an integrated inventory of 10 million acres in the Yukon-Porcupine Rivers area of Alaska using high altitude color infrared photography. The problems encountered and resolved in using high altitude photography for photo interpretation and fieldwork are discussed. Note is made of the difficulties in conducting a multiresource inventory involving several disciplines and agencies. The discussion concludes with comments on preliminary inventory results and with recommendations for improving subsequent inventories of this type.

21 HEGYI, Frank.
1978. Technological Changes in Forest Inventory in British Columbia. Paper Presented to the Western Mensurationists Subcommittee of the Western Forestry and Conservation Association at Sacramento, CA. Dec. 5-7, 1978.

The forest inventory techniques of the British Columbia Forest Service have been upgraded significantly. In the inventory, the sampling designs are being optimized and data management enhanced

through the use of new and sophisticated computer equipment. It is planned that within one year, the central system will be accessible from any part of the Province through remote terminals, hence, resource managers will be able to obtain much needed up-to-date multi-resource inventory data within minutes.

22 HELLER, Robert C.
1978. Role of Remote Sensing: Moderator's Comments. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 204.

Most of us agree that we must use some level of remote sensing data to make integrated inventories in an efficient way.

23 HELLER, Robert C. (technical coordinator).
1975. Evaluation of ERTS-1 Data for Forest and Rangeland Surveys. U.S.D.A. Forest Serv. Res. Pap. PSW-112, 67 pp.

Tests used data gathered by the first Earth Resources Technology Satellite. Results on sites in Georgia, Colorado, and South Dakota indicated that ERTS enlargements, preferably color, would be useful to forest managers of large ownerships for broad area planning. Forest land was distinguished from nonforested land with 90 to 95 percent accuracy, in both photointerpretation and computer-assisted analysis. Further breakdowns of cover types could not be made with acceptable accuracy by either method. Forest disturbances from natural causes or human activity could be detected with 90 percent accuracy when ERTS imagery was compared with 6-year-old aerial photos. Stress from mountain pine beetle could not be detected; ERTS wavebands are too broad to identify dying foliage.

24 HENDERSON, J. A., and L. S. Davis.
1978. ECOSYM: A Classification and Information System for Wildlife Resource Management. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 384-391.

ECOSYM is an approach to classifying wildland ecosystems by ten basic components (Bedrock geology, Regolith, Elevation, Slope, Aspect, Temperature, Precipitation, soil, Current Vegetation and Potential Vegetation) and an information handling and delivery

system which uses this classification both in the data acquisition and data retrieval stages. Management information is related to the classification by "rules" and is accessible either in quantitative format or as maps. Integration of the basic components occurs at the management or decision-making level rather than being structured into the basic classification.

25 HENDERSON, J. A., L. S. Davis and E. M. Ryberg.
1978. ECOSYM: A Classification and Information System for Wildland Resource Management, Utah State University, Logan, 50 p. mimeo.

26 HERRINGTON, L. P. and G. E. Bertolin.
1974. Measurement of the Physical Environment. In Monitoring Forest Environment through Successive Sampling. June 1974. State University of New York, College of Environmental Science and Forestry. p. 170-176.

This paper contains a brief introduction into the problems of measuring physical factors in the forest. We will look at the variables themselves, the different types of variability encountered, and the major problems of the measurement process.

27 HILDEBRANDT, G.
1976. Mapping, Inventory and Monitoring of Forest and Rangeland in the Tropics, Requirements and Objectives, In Interregional Training Seminar on Remote Sensing Applications, Lenggries, West Germany, 1976, Proc.: UN-FAO and Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt E.V., p. 131-137.

28 HILDEBRANDT, G.
1976. Remote Sensing in Forestry. Proceedings of the Symposium Held During the XVIth IUFRO World Congress. Oslo, Norway.

The text covers the entire area of remote sensing including: Interpretation, spaceborne radar, computer-aided analysis, mapping, acreage estimation, remote sensing of tropical forest, with special emphasis on imagery application in forestry.

29 HILDEBRANDT, G. (Edited by)
1973. Proceedings Symposium. International Union of Forest Research Organizations, Subject Group Remote Sensing, Including Aerial Photography, S 6.05, Freiburg, 1973. Printed 1974 Abteilung Luftbildmessung und Luftbild Interpretation der Universitat.

Summary of the proceedings of the above. Main topics are: Photo interpretation in tropical forests, application of photo interpretation in environmental research, forest - and land use - inventory forest. Mensuration by photointerpretation, forest mapping and photogrammetry, interpretation of spaceborne imagery, approaches of automated and digitized evaluation of aerial photography, problems of organization in national and international remote sensing programs.

30 HILL, D. E., and H. F. Thomas.
1972. Use of Natural Resource Data in Land and Water Planning. Connecticut Agri. Exp. Sta. Bull. No. 733. New Haven, CT. 47 p.

The integration of geological, hydrological and soil data to provide a base for preliminary land and water use planning is demonstrated. From basic resource maps, single factor maps were derived which delineated areas having specified basic characteristics. By overlaying selected single factor maps relevent to a specific management problem, areas justifying detailed field survey are distinguished.

31 HILLS, G. A.
1976. An Integrated Interpretive Holistic Approach to Ecosystem Classification. In Ecological (Biophysical) Land Classification in Canada. pp. 73-98.

A discussion of those features of non-living physiosystem which provide a basis for establishing homogeneity at various levels of investigation.

32 HIRSCH, Allan, Charles T. Cushwa, Klaus W. Flach and W. E. Frayer.
1978. Land Classification--Where Do We Go From Here? Jour. Forestry. 76(10):672-673.

Land classification systems provide means of aggregating large amounts of information, and of extrapolating research results and management experience among units with similar properties. The dilemma for the future is that while land classification is becoming more complex and there is urgent need for coordination, no single approach can serve all purposes. Recommendations for future directions include continued research to develop applicable

systems, emphasis on hierarchical approaches and use of natural biosphere components as a basic underpinning, development of new ways to use a number of systems simultaneously, and continued emphasis on communication mechanisms.

33 HIRVONEN, R. and R. J. Madill.
1978. Fundy National Park, N. B. and the Proposed Western Extension Integrated Resource Survey. Canada Forest Management Inst. Inform. Dept. FMR-X-105. 225 p.

34 HIRVONEN, R. and R. A. Woods.
1978. Integrated Resource Study of Georgian Bay Islands National Park. Forest Management Institute; Ottawa, Ontario Information Report FMR-X-117. 82 p.

The land, vegetation and surface drainage patterns of Georgian Bay Islands National Park are described and mapped at the scale of 1:10 000. The park is divided into physical and forest character types. The basic physical unit is the land type, being separated on the basis of topography, drainage, soil texture, geomorphic origin and depth to bedrock. The vegetation is mapped by forest types, as described by species composition, stand height, crown closure and stand condition, or by non-forest areas. Ground vegetation communities are determined from species composition and their cover abundance by cluster analysis, and are described by their ecological parameters. Brief discussion on interpretation and application of the survey data are included in the text.

35 HIRVONEN, R. and R. Woods.
1978. St. Lawrence Islands National Park and Surrounding Areas; Integrated Resource Survey. Forest Management Institute Ottawa, Ontario Information Report FMR-X-114. 57 p.

The land, vegetation and surface drainage patterns of St. Lawrence Islands National Park and surrounding areas are described and mapped at the scale of 1:10 000, except Cedar, Milton and Stovin islands which are at 1:5 000. The land resource is mapped at the land type level where segments of the landscape are separated on the basis of their topography, drainage, soil texture, origin of parent material and depth to bedrock. The vegetation is mapped by basic non-forested categories or by forest cover types as defined by stand height, species composition, crown closure and stand condition. Major soil types, forest cover type groups, lower vegetation communities, drainage and rivers are described in the text.

36 HOFFER, Roger M.
1972. Land Utilization and Water Resource Inventories over Extended Test Sites. In 4th Annual Earth Resources Prog. Rev. 2(48):39 p.

37 HOFFER, Roger M. and Michael D. Fleming.
1978. Mapping Vegetative Cover by Computer-Aided Analysis of Satellite Data. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 227-237.

Several techniques involved in digital analysis of data from satellite scanner systems are discussed. Major cover types for a mountainous test site of approximately one million hectares were mapped with an accuracy of over 85% using both Landsat and Skylab data. Acreage estimates based on computer analysis of satellite data were compared to photo interpretation estimates, resulting in correlation coefficients ranging from 0.93 to 0.97. Topographic data (elevation, slope, and aspect) were digitally overlayed onto the satellite data, creating a data base that enabled various map products to be produced for resource management purposes.

38 HOLDRIDGE, L. R. and J. A. Tosi.
1974. The World Life Zone Classification System and Forestry Research. Proc. 7th World For. Cong. 1972 Buenos Aires, Arg. p. 4862-4773.

The system is briefly described. Three hierarchical levels are involved. Level I, The Life Zone, is determined by quantitative ranges of long-term average annual precipitation, mean annual biotemperature and the potential evapotranspiration ratio, the last two terms being defined in the paper. Each Life Zone may contain a number of examples of Level II, the Association, which in turn may contain a number of examples of Level III, a non-climax Successional Stage or the man-made Cover Type, the ultimate subdivision of the system.

39 HOLLING, C. S., ed.
1977. Adaptive Environmental Assessment and Management. Report PR-6, Institute of Resource Ecology, University of British Columbia, Vancouver, B. C. 595 pp. + Appendices.

This book is a report on our efforts to develop an adaptive approach to environmental impact assessment and management. It is written for policy makers and managers who are dissatisfied with traditional procedures and principles and who seek some effective and realistic alternatives.

40 HOPKINS, L. D., R. Wood, D. Brochmann, and L. Messina.
1973. Environmental Impact Statements: A Handbook for Writers and Reviewers. Chicago, IL: Ill. Inst. for Env. Qual. 202 p.

This handbook was prepared for writers and reviewers of Environmental Impact Statements (EIS) in the State of Illinois. It provides a basic introduction to the preparation of these statements and gives suggestions for content, organization, and format presentation. This report is directed at impact statements for projects of concern at the state, rather than local or federal level; e.g. Reservoirs, stream channelization, highway links, mining operations and public facility locations. There are four basic sections to the handbook: Chapter I suggests an organization for writing of the EIS; Chapter II reviews environmental impact assessment methods; Chapter III gives annotated examples of impact statements; Chapter IV lists important sources of information concerning environmental effects.

41 HOUSE, Louis O. IV.
1978. Integrated Resource Inventories of Industrial Forest Land. Integrated Inventories of Renewable Resources: Gen.Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 147-149.

The need for different kinds of integration of forest inventories is discussed in the context of the economic and social environment of industrial landowners.

42 HOWARD, John A.
1965. Small Scale Photographs and Land Resources in Nyamweziland (Tanzania), East Africa: Photogramm. Eng., 31(2):287-293.

Up to the present time, very little has been published concerning the photo interpretation of areas of tropical woodlands as distinct from tropical closed forests. The writer shows how the woodland formation can be divided into nine main forest types and ten land types for agricultural purposes. In addition, suggestions are put forward concerning grazing, big game protection and the control of endemic disease.

43 HOWARD, John A.
1974. Concepts of Integrated Satellite Surveys, In Earth Resources Technology Satellite-1 Symp., 3rd, Washington, D. C. 1973, Proc.: Washington, D. C., Sci. and Tech. Inf. Office, NASA, NASA SP-351, 1(A):523-531.

44 HUGENTOBLER, U.
1977. Bedeutung der Integralen Inventur; Importance of Integrated Inventory. J. For Suisse 128 (1):28-29.

The needs for total coverage of state, cooperative and private forests are stressed.

45 HUGHES, Jay M.
1974. Multiresource Inventories--Rhetoric or Reality. Proceedings of the Inventory Design and Analysis Workshop. Soc. Amer. For., Inventory Working Group. p. 157-161.

Why do we need a multiresource inventory? 1. Almost all our forest resource data deals almost solely with timber. 2. The emerging process of issue definition and resolution in natural resource program development and management seems to require an extended range of kinds of resource data. 3. Also, there is an increased interest in resource inventories per se.

46 HUGHES, Jay M. and Thomas E. Hamilton.
1978. A Framework for Continuous Assessments of the Forest Resource Base. Paper Presented at the Eighth World Forestry Congress, 16-28 Oct. Jakaria, Indonesia. FID-I/16-12 7 p.

What we have presented here are some key points for consideration in framing a forest resources assessment. In summary they are:

--The purpose or purposes of an assessment must be clearly stated at the outset.

--Forest resource assessments are most useful if done on a recurring basis in order to demonstrate and account for change.

--To help assure cooperation in preparing a forest resource assessment and to gain more widespread use of results, an organization should have clear authorization and responsibility before undertaking a job.

--Availability of analytical techniques can be as limiting a factor as availability of data in the preparation of an assessment.

--Identification and use of a variety of data sources can pay large dividends in assessment efficiency and acceptability of results.

--When a resource inventory is required, proper inventory design can greatly improve the information obtained from a given dollar outlay.

--Procedures for handling assessment data should be developed concurrently with collection procedures.

--Simultaneous collection of data for a variety of purposes can be cost-effective, but the integrity of information needed for the assessment must be maintained.

--Involvement of users throughout the assessment's process can greatly enhance its usefulness and acceptability.

Assessment of forest resources is a complex task, regardlsss of the purpose for the assessment. While it is unreasonable to expect a single assessment to provide for all needs, a single assessment can be designed to address multiple objectives.

However, when designing an assessment, care should be taken not to include too many objectives and not to promise more than can be provided. Two features which should be kept foremost in the mind of the persons responsible for periodic assessments are:

1. Improvements can continually be made, and perhaps the single best guide to these improvements is assessment experience.

2. The questions which a periodic assessment must address are constantly changing, and the usefulness of an assessment is directly proportional to its anticipation of and adaptability to these changes.

These two features require that one overriding concept must be retained in all assessment efforts--that concept is flexibility. Without flexibility, we can be certain that an ongoing assessment of forest resources will fall short of its goals.

47 HUSCH, B.
1971. Planning a Forest Inventory. Food and Agriculture Organization of the United Nations. Rome, Italy 117 p.

Although the reasons for carrying out inventories may vary, there is a unity in their planning and execution regardless of the diverse ends to which the resultant information may be directed.

48 HUTCHINSON, Charles Frederick.
1978. The Digital Use of Landsat Data for Integrated Land Resource Survey: A Study in the Eastern Mojave Desert. University of California, Riverside. Ph.D. Diss. 277 p.

It is postulated that the digital use of the Landsat signal, in recognizing integrated units of terrain, would both lend precision to survey and also be a reasonable use of the integrated data. The integration of landscape attributes is not perfect, and spectral signature of each class of unit is unlikely to be statistically discreet. However, the dubious validity of comparing several different classification of land (including soil, land form, and vegetation) contributes an equal amount of uncertainty to the interpretation of results.

I

01 IUFRO.
1978. National Forest Inventory - Proceedings Joint Meetings of IUFRO Groups S.4.02 and S.4.04. June 18-24, 1978 - Bucharest, Romania. 655 p.

A collection of papers on National Inventory Systems in use around the world.

J

01 JACKS, Jack, Dean Pennington, and Lynn Kantner.
1978. Disintegrated Inventories of Natural Resources. Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For Serv., U.S.D.A., Fort Collins, CO. p. 37-41.

Mineral resource inventory is customarily avoided because it is expensive and time consuming. Mineral information inventory can serve a similar purpose, but with little expense. This paper tells how to provide important minerals information to help guide use, development, and protection of other resources.

02 JENKINS, Robert E.
1977. Classification and Inventory for the Perpetuation of Ecological Diversity. In Classification, Inventory and Analysis of Fish and Wildlife Habitat; Symposium, U.S.D.I. Fish and Wildlife Service. FWS/OBS-78/76. p. 41-52.

Efforts to systematically preserve examples of all of the elements of ecological diversity extant in North America are described. The importance of rigorous, systematic effort is stressed and the State Natural Heritage programs, already operating in nearly a dozen states, are described. The program employs a classification of the "elements of ecological diversity" consisting mainly of biological community/ ecosystems types and special species habitats. A cyclical inventory process is employed to collect information for a continuously operating, "balanced" information management system. These processes are used to create a dynamic atlas and data base on the existence, characteristics, numbers, conditions, status, location, and distribution of examples of the elements of natural ecological diversity. The ultimate purpose is to select and protect adequate representatives of each of the elements so as to perpetuate the fullest possible array of species, communities, and other ecological components and phenomena.

03 JENSEN, Chester E.
1973. MATCHACURVE-3: Multiple-Component and Multidimensional Mathematical Models for Natural Resource Studies. U.S.D.A. Forest Serv. Res. Pap. INT-146, 42 pp.

Mathematical model development procedures for graphed relations between variables are presented. As an extension of single-component two-dimensional model alternatives given in the two previous papers of the Matchacurve series, the author concentrates on multiple-component and multidimensional modeling. These procedures are particularly useful in describing unique main effects and interactions. A detailed application is given for a heavily convolute surface developed from "live" data.

04 JENSEN, Mark S. and Merle P. Meyer.
1976. A Remote Sensing Application Program and Operational Handbook for the Minnesota Dept. of Natural Resources and other State Agencies. Remote Sensing Lab., College of Forestry, University of Minnesota, St. Paul, Minnesota.

Report concerns results of a multi-study program to determine the practical capability of remote sensing techniques as a means to provide efficient (practical), cost-effective solutions to the resource data needs of Minnesota's resource management agencies.

05 JOHNSON, James Russell.
1974. Small Scale Photo Probability Sampling and Vegetation Classification in Southeast Arizona as an Ecological Base for Resource Inventory. Ph.D. Diss. Oregon State University, 201 p.

This paper reports on three meaningful research contributions in remote sensing of natural vegetation. They are (1) a natural vegetation classification suitable for remote sensing use, (2) a technique for objectively comparing space imagery for relative information content, and (3) a sample scheme for using small scale photography to identify and estimate areas of vegetation types.

06 JOHNSTON, D. R.
1978. Resource Management Systems - The Cost. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO p. 382-383.

The capability and cost effectiveness of any Resource Management System can only be judged in a real environment where useable products are being produced. In evaluating systems the user must decide whether he is going to buy an existing system or take the more costly and time consuming route of developing his own. Using a Data General Eclipse computer the operating costs of the Comarc System are discussed along with methods of increasing the effectiveness of data utilization. Specific examples of data output and related costs are illustrated.

07 JURDANT, M. et al.
1974. Ecological Land Survey: I. In Canada's Northlands; Proceedings of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands Ecological Land Classification Series, No. 0. p. 23-30.

Land produces trees, agricultural crops, water, wildlife and aesthetic or recreational values. All these renewable resources of the land interact or compete in such a way that man can direct their productions according to his needs. Yet both the productivity of these land resources and the interactions vary in space and in time depending on the biological and physical characteristics of the land itself. A comprehensive and quantitative knowledge of the biophysical characteristics of the land is, therefore, a prerequisite to land planning and land management. Such a knowledge is obtained by an ecological land survey when it provides:

1) A survey of the land itself, which includes the description, classification and mapping of the land,

2) Interpretations of biophysical characteristics of the land which are useful for land planning and land management, and

3) A better knowledge of the relationships between soil, climate and vegetation.

K

01 KAISER, H. F., DeBowker, K., Lockard, Ronald and Putnam, J. W. 1972. Forest-Range Environmental Production Analytical System (FREPAS). U.S.D.A. Agr. Handbook No. 430, 211 p.

This is one of four reports that present the concepts, procedures, information, and analyses developed in the Forest-Range Environmental Study (FRES), Forest Service, U.S.D.A., 1970-1972.

The basic document is:

- The Nation's Range Resources--A Forest-Range Environmental Study. This report presents basic concepts and methods, information on supply and demand for resources from all the Nation's forest-range environment, and analyses of alternative mixtures of resource use.

Supporting The Nation's Range Resources--A Forest-Range Environmental Study are:

- Forest-Range Environmental Production Analytical System (FREPAS), the analytical and computer capability developed for FRES.

- Vegetation and Environmental Features of Forest and Range Ecosystems, a system of classifying all the land area of the 48 contiguous States into 34 units called "ecosystems," and a description of each.

- Range Management Practices: Investment Costs, 1970. Definitions of the 18 range management practices used in the Forest-Range Environmental Study (FRES) and lists of investment costs for each practice in each of 956 resource units of forest-range found within 34 major ecosystems.

02 KALTENBERG, Michael C. 1978. Evaluation of Regeneration Sampling Methods: A Monte Carlo Analysis Using Simulated Stands, DNR Report No. 39. State of Washington, Dept. of Nat. Res., Olympia, Washington, p. 50.

Eight regeneration survey rules using one of three sampling methods --fixed area, polyareal, or distance sampling--were evaluated for accuracy and efficiency in estimating stems per acre and stocking. Nine simulated populations--uniform, random, and aggregated distributions for 200, 500, and 1000 stems per acre--were examined. Cost functions were used to equalize sampling intensities. Sampling was systematic with a random start. A Monte Carlo procedure generated expected values and varainces to determine bias and efficiency. Survey rules based on the fixed area method (stocked quadrat, list quadrat, mil-acre circular plot, and 1/250 acre circular plot) gave accurate estimates over the range of distributions and densities. The trade-off between plot size and number of plots determined relative efficiency rankings. Polyareal rules (vertical line and vertical point) also accurately estimated stems per acre (SPA) and stocking, but were less efficient than the fixed area rules. The distance rules (nearest tree and variable radius) produced biased estimates for stems per acre. Of these distance rules, only the nearest tree rule estimated stocking; however, it used a fixed area approach to do so.

03 KATZ, Amrom H.
1967. Reflections on Satellites for Earth Resource Surveys: Personal Contributions to a Summer Study. Rand Corporation, Santa Monica, CA. Rept. No. P-3753, 36 p.

The case for aircraft in earth resource surveys: Discussion of a proposed aircraft system for earth resource surveys, or how to meet all requirements with men in aircraft: A discussion of a hypothetical photo satellite system for land use survey: Facing the analysis problem: How to start: The limiting case.

04 KAUL, R. N.
1973. An Integrated Natural Resource Survey in Northern Iraq. Nature and Resources 9(2):13-18.

The survey was carried out by a team of Iraqi specialists, assisted by Unesco experts. It was to provide basic data for a further joint FAO/Unesco/WMO agroclimatological survey which was to examine the climatic needs and tolerance of both traditional wheat and of the 'Mexipak' variety. The latter variety has been recently introduced on a large scale in this part of the fertile crescent and is reputed to have an optimal productivity under more severe fertility and irrigation conditions than the traditionally cultivated wheat species. The detailed results of the integrated survey were published in the internal 'Technial Reports' series of the institute.

05 KEECH, M. A.
1977. An Assessment of ERTS-1 Imagery as a Base-map for Natural-Resource Surveys in Developing Countries. In Bristol Symp. on Remote Sensing, 2nd, Bristol, U.K., 1977, Environmental Remote Sensing 2: Practices and Problems: Bristol, U. K., Univ. of Bristol, Dept. of Geog., p. 246-258.

Examples in Rhodesia and Sierra Leone are given.

06 KESSELL, Stephen R.
1974. Wildland Inventories and Fire Modeling by Gradient Analysis in Glacier National Park. Tall Timber Fire Ecology Conference and Fire and Land Management Symposium Meeting at Univ. of Montana, Missoula, MT. Published by Tall Timber Research Stn., Bull. 14, pp. 115-162. Tallahassee, FL.

Shows the Glacier N.P. fire modeling scheme. The article describes (1) a simple step-by-step example of the development and use of a gradient model for a hypothetical forest ecosystem, and (2) a documental description of the Glacier National Park model as it relates to fire management, including description of fuel loadings and spatial distributions, and the effects of the latter on stochastic elements of fire spread modeling.

07 KESSELL, Stephen R.
1977. Gradient Modeling: A New Approach to Fire Modeling and Resource Management. Ecosystem Modeling in Theory and Practice (Text), pp. 576-603.

Gradient modeling is a computer-based resource modeling system designed in Glacier National Park to meet the needs for a resource-information system, a resource inventory, and a fire-modeling package. It provides these capabilities by linking four major components:

1. A terrestrial resource inventory system
2. Gradient models of the vegetation and flammable fuel
3. Weather and micrometeorology models
4. Fire behavior models

08 KHAN, C. and M. Anwar.
1974. "New Adjustable, Decimal, Collapsible Quadrat vs. Three Old Quadrats - An Evaluation." Jour. 27(1):71-75.

This paper presents an evaluation of a new adjustable, decimal, collapsible quadrat (ADCQ) of meter square size in comparison with three other quadrats employed for range vegetation sampling in Pakistan since 1966. In addition to size of quadrats, the different modes of subdivisions built in as an aid for estimation of vegetation cover within the same sized quadrats affected very significantly the different attributes of quadrats as well as quality of data recorded. The new quadrat was faster than other meter square quadrats to a highly significant extent and was as fast as canopy coverage quadrat (CCQ) with only 0.15m in size. The new coefficient of variation for the new quadrat was significantly less than CCQ. The new quadrat was more precise in sampling major species than all other quadrats.

09 KHAN, F. M.
1977. Pre-Investment Survey for Natural Resources Development in Northern Pakistan. Pakistan Jour. For., Jan:11-24.

With increased population, pressure on land for cultivation, grazing and timber supplies is also increasing in the NW hilly part of Pakistan. This is also part of the Indus watershed, a major source of water for agriculture, domestic and industrial uses, and power. With a view to conserving and developing these watersheds, the pre-investment Survey Project for Natural Resources Development was launched in 1965 to collect inventory data and interpret them for drawing up of land use plans. Much work has already been completed on aerial photography, preparation of maps, and drawing up of integrated land resources reports. Some follow-up operational projects have been implemented. Aerial and LANDSAT images of forest areas compare favourably.

10 KHARIN, N. G.
1974. Distant Methods and the Problem of Natural Resource Inventory. Probl Osvoeniya Pustyn' (3):3-7.

11 KING, R. B., and A. Blair Rains.
1974. A Comparison of ERTS Imagery with Conventional Aerial Photography for Land-Resource Surveys in Less Developed Countries, Examples from the Rift Valley Lakes Basin, Ethiopia. ESRO Rep. SP Ser (Neuilly) 100:371-379.

12 KIRBY, Malcolm.
1975. Land Use Planning, Transportation Planning, and Interger Programming. In Systems Analysis and Forest Resource Management Proceedings Workshop by SAF, Univ. of Georgia, Athens. p. 271-284.

Land use planners often must attempt to satisfy conflicting objectives: schedule timber sales in a desirable sequence; break-even financially; minimize sales and road costs; stabilize cutting levels over time; maximize forage capacity; minimize sedimentation, and provide adequate transportation systems, are among them. Some of these objectives are mutually exclusive and others cannot be rationally quantified. But, one such objective which can be incorporated as a constraint on the land use plan is road construction.

This paper discusses the usefulness of mathematical programming techniques in analyzing complex problems in land use and transportation. The intent is not to introduce specific applications but rather to suggest the potential range of application of mathematical programming.

13 KITCHINGS, J. T. and N. E. Tarr.
1978. National Environmental Research Park Symposium: Natural Resource Inventory, Characterization and Analysis. Proceedings, 15 Aug 78, Los Alamos, NM. 183 p.

Separate abstracts were prepared for the 14 papers presented at the Conference. These covered environment, animals, inventories, land use, plants, population dynamics, research programs.

14 KITCHINGS, J. T., et al.
1978. Approaches to Natural Resource Inventory and Analysis on the Oak Ridge Environmental Research Park. In National Environmental Research Park Symposium; Natural Resource Inventory, Characterization and Analysis, 148-163. Los Alamos, NM.

The principal effort of the Department of Energy's Environmental Research Park program on the Oak ridge Reservation is directed at identification and preservation of a diverse assortment of natural communities representative of the Appalachian region of East Tennessee. Designation of natural areas provides a degree of protection for unique plant and animal species. Concommitantly, establishment of research reference areas provides sites which will be used to evaluate changes brought about in similar natural communities as a result of activities related to energy-producing technologies. Agglomerative cluster analysis of 184 continuous forest inventory (CFI) plots on the Reservation initially was used to objectively define forest types. Thus, types identified by cluster analysis formed a basis for determining what forest elements were present and which were representative of the Appalachian region. Subsequently, cluster analysis similarly was used within these research areas to define the overstory, understory, and shrub structure of the particular forest community.

15 KLINGEBIEL, A. A. and V. I. Meyers.
1974. An ERTS-Based Land Resource Inventory for Mexico's National Water Study. Soil Conserv. 40(4):18-20.

Assignment to pioneer in the development of a plan and procedure for the preparation of a potential land use map of Mexico. Maps are based on interpretation of available soil and related resource data and on the use of ERTS imagery.

16 KOWALL, R. C. and G. G. Runka.
1968. Guidelines for Bio-Physical Land Classification. Misc. Rpt. Canada Land Inventory. Ottawa, Ont. 27 p.

17 KREBS, C. J.
1972. Ecology: The Experimental Analysis of Distribution and Abundance. New York: Harper and Row. 678 p.

A textbook about ecology dealing with the problem of distribution, problem of advance, abundance at the community level.

18 KUCHLER, A. W.
1964. Potential Natural Vegetation of the Conterminous United States. (Manual and Map) Am. Geogr. Soc. Spec. Publ. 36, 1965 Rev., New York. 116 p.

The new vegetation map is the fruit of continuous and intensive cooperation between the author and several colleagues. Contents of the book are (1) Aspects of Vegetation, (2) Units of Vegetation, (3) Map Legend, (4) The Colors, (5) Photographs, (6) Selected Bibliography, and (7) Description of Legend Items.

19 KUCHLER, A. W.
1973. Problems in Classifying and Mapping Vegetation for Ecological Regionalization. Ecology 54(3):512-523.

Important research carried on currently in ecological regionalization calls for a close look at the role of classifying and mapping vegetation, as both these activities can be of fundamental significance in regionalization. A correlation of classifying and mapping vegetation with ecological regions requires an analysis of vegetation, classifications, regions, and maps.

The analysis of vegetation revealed the character of biogeocenoses, plant communities, and continua and, incidentally, made it clear that the correct term for the science of vegetation studies is phylocenology. Problems of vegetation boundaries can develop when continua are compared with transitions. This is important in mapping, where the nature and location of boundaries is of major significance. Vegetation is best divided into natural and cultural vegetation and further subdivided on the basis of (1) physiognomy and structure, (2) floristics, (3) community dynamism, and (4) community relations with their respective biotopes.

When these units were applies to an analysis of classifications, it developed that a basic distinction must be made between highly flexible, purely descriptive and essentially classless approaches on the one hand, and clearly organized hierarchies on the other. Serious difficulties can arise when a detailed description of vegetation is related with a classification, and an important distinction emerging from these findings is between worldwide and regional classifications. Multiple mapping at large scales evolved into a particularly useful and enlightening method.

20 KULOW, D.
1966. Comparison of Forest Sampling Designs. J. For. 64(7):469-474.

To test the accuracy of current forest sampling techniques, three forest areas were mapped to scale and sampled by 144 sampling designs. Six plot sizes were applied to each of six areal plot shapes. The types of Bitterlich points were examined on a basal area factor of 5, 10, 20, 30, 40, and 50. One type was adjusted for edge bias according to Grosenbaugh's peripheral zone scheme, while the "unadjusted" points were corrected by formula during analysis. All of these sample unit shapes and sizes were then applied to random, systematic, and multiple-random-start distributions. The precision of each method was tested by running an analysis of variance on the sampling error of each design. Accuracy was measured by comparing the estimated means with the actual means. The 1/5th and 1/10th acre plots and the RAF-5 and BAF-10 point-samples were all equal with respect to these two parameters. The distribution design affected precision and accuracy, but not decisively so. On one forest all were equally precise, but the random was the most accurate. On the second forest, precisions were equal but the systematic design was most accurate. On the third forest, all were equally accurate, but the random design was the most precise. The multiple-random-start design was very inaccurate when analyzed by cluster analysis techniques. Grosenbaugh's peripheral zone techniques produced results

that were neither precise nor accurate. Precision and accuracy by this method varied universally with the proportion of the population sampled. Plot shape was of no consequence in this study.

21 KUNG, Fan H.
1975. A Handbook of Graphical Solutions to Forest Biometric Problems. Dept. of Forestry Publication No. 12. Southern Illinois University, Carbondale 89 p.

Handbook covering such topics as descriptive statistics, nonparametric statistics, parametric statistic (normal and binominal distribution data) experimental design and heritability.

L

01 LA BAU, V. J.
1978. State of the Art: Moderator's Comments. Integrated Inventories of Renewable Natural Resources. Proceedings from a Workshop, U.S. Rocky Mtn. Forest and Range Exp. Stn. U.S.D.A. For. Serv. Gen. Tech. Rept. RM 55: p. 392-394.

A summarization of the current status of integrated multiresource inventories with emphasis on planning, techniques, land classification systems, remote sensing, data processing and mapping. The state of the art is pictured as a collage of many different objectives, techniques, and methodologies. Emphasis is placed on cost evaluations.

02 LACATE, Douglas Stewart.
1969. Guidelines for Bio-physical Land Classification. Can. For. Serv. Publ. No. 1204, 61 p.

The terms of reference of the Subcommittee on Bio-physical Land Classification are:

(1) To examine and review systems of land classification developed and used at national and regional levels.

(2) To present recommendations to the National Committee on Forest Land concerning a suitable physical land classification, of a reconnaissance nature, that will provide a base from which lands can be classified as to their use for Forestry, Agriculture, Recreation, Wildlife and Water Yields.

03 LACATE, Douglas Stewart.
1970. The Role of Resource Inventories and Landscape Ecology in the Highway Route Selection Process. A Case Study Using the Proposed Relocation of New York State Route 13. PhD. Dissertation. 220 p.

There are many deficiencies in existing highway route selection methods that are related to both the inadequacy of the criteria for route selection and the critical issue of establishing appropriate mechanisms through which the affected community can introduce its framework of values into the route selection process. The highway route selection process is considered in this study as a hierarchically-structured process having several levels at which route location problems can be visualized and examined. This study and report are concerned primarily with the examination of highway location problems related to the selection of the Band of Interest (level 1), Location Corridors (level 2) and Proposed Alignment (level 3) - those levels of activity which precede major highway engineering and design activities. The proposed relocation and reconstruction of New York State Route 13 is used as a case study.

04 LACATE, Douglas Stewart and M. J. Romaine.
1978. Canada's Land Capability Inventory Program. Jour. of Forestry; 76(10):669-671.

The Canada Land Inventory was conducted cooperatively by the federal and provincial governments to provide an information base for a variety of land-use planning and rural development activities, including recent applications in assessment of potential environmental impacts. This inventory program comprised a series of interpretive classifications developed for agriculture, forestry, wildlife, and recreation. The land-capability ratings were based on an evaluation of information available in existing soil-landform and vegetation surveys, or obtained through new biophysical land-classification surveys in previously unsurveyed areas.

05 LANG, R.
1978. Environmental Information in a Planning/Management Context. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7 285-294 p.

Environmental problems present a dilemma: while environmental systems function in an interrelated holistic manner, institutional systems intended to deal with these problems tend to function in a

disjointed separated manner. The more complex the natural/human aspects of the problem and the more agencies involved in implementation, the less appropriate are holistic prescriptions (comprehensive data base, comprehensive plan, super-department). More attention must be given to the needs of users and those affected by planned actions, and instead of an ends-to-means sequence from information to planning and implementation, there must be a diversity of planning inputs throughout management processes. Opportunities to diversify arise in both the horizontal and vertical dimensions of any organization. A building block approach allows discrete initiatives to proceed incrementally, with the intent of eventually linking them within an integrated environment management framework.

06 LANGLEY, Philip G.
1969. New Multi-stage Sampling Techniques Using Space and Aircraft Imagery for Forest Inventory. Proc. Sixth Int. Symp. on Remote Sensing of Environment. Univ. Mich., Ann Arbor, MI. p. 1179-1192.

A new multi-stage sampling technique, with wide application in earth resource surveys using remote sensing, has been developed and tested on several occasions. For the first time, a complete theory is available with the capability of utilizing information from sample imagery of increasingly finer resolution simultaneously. First-stage samples are selected at random from space or aircraft imagery with probability proportional to a prior prediction as to the relative resource quantity contained in the population units. Increasingly higher resolution imagery is obtained on subsamples within subsequent stages, again with probability proportional to the prediction made at the appropriate stage. Finally, sampling is undertaken on the ground to obtain the necessary ground-truth data. These ground measurements are expanded through the system to obtain estimates that are valid over the entire area of interest. The method has been proven to yield unbiased estimates, and furthermore the sampling error depends solely on the accuracy of the predictions made at each stage. Consequently, the estimates are free of the sampling errors customarily arising by virtue of the inherent variation existing between the raw population units. Allocation formulas have been developed for optimally allocating survey funds to minimize the sampling error for a given fixed cost of the survey.

07 LANGLEY, Philip G.
1971. Multi-stage Sampling of Earth Resources with Aerial and Space Photography. In Monitoring Earth Resources From Aircraft and Spacecraft, NASA SP-275M, GPO. Wash., D.C. p. 129-142.

Categorizing the Earth's resource information on a vast scale is not a simple matter. One must consider the desirable levels of accuracy and precision of the information in terms of economic feasibility. Obtaining detailed and complete data for every parcel of land over vast areas is not now feasible for various reasons. Therefore, the only feasible method of obtaining detailed resource information, applicable to large land areas, is by means of sample estimates - even when remote sensors are used from space.

08 LANGLEY, Philip G.
1971. The Benefits of Multi-Stage Variable Probability Sampling Using Space and Aircraft Imagery. In Applications of Remote Sensors in Forestry. Joint Report by Working Group, International Union of Forest Research Organizations, Section 25, p. 119-126.

A new efficient multi-stage technique devised for application to resource inventories combines remote sensing from several altitudes with ground measurements. The method takes advantage of the increasingly finer resolution of remote sensor imagery that may become available on a sampling basis to increase the efficiency of sample selection in each subsequent stage. The precision of the estimated totals depends solely on the relationships between predictions made by image interpretation and the value of measured characteristics of the sample units used to estimate population parameters. Hence, the efficiency of a resource survey using the method depends on the quality of the image interpretation. The method is easy to use, operationally efficient, and provides for a greater proportion of the work to be carried out in the areas of higher value. Furthermore, the method obviates the need to know the exact land area encompassed by sample plots, thus greatly simplifying the photogrammetric aspects of resource survey work.

09 LANGLEY, Philip G.
1975. Multi-stage Variable Probability Sampling: Theory and Use in Estimating Timber Resources from Space and Aerial Photography. Ph.D. Dissertation, University of California, Berkeley, University. 101 p.

Nearly all forest managers as well as those engaged in setting forest policy have a need for information concerning the quantity, quality, and distribution of forest resources. Two major technological developments during the past several years have oriented research in forest inventory techniques in new directions. These developments are

(1) computer technology and resource information systems, and (2) the advent of high altitude aircraft satellites fitted with remote sensors which collect vast quantities of data relating to earth resources. Optimal efficiency in resource surveys can perhaps be obtained by beginning with a rudimentary forest resource information system containing complete but broad data about the resource base. Then sampling plans utilize these data to stratify the population most effectively and to generate supplementary variables for use in sampling for specific components of the resource base. As new surveys are undertaken, portions of the resource base are strengthened which, in turn, provides better data for increasing the efficiency of subsequent surveys. Multistage variable probability sampling is one technique which lends itself to this overall concept very advantageously under certain conditions which are explained herein. One void in the literature is an adequate guideline for the optimal allocation of samples to various stages of a multistage sample survey with variable probabilities. An attempt at such a guideline is given. The derivation of the multistage theory and selected examples of the use of the technique as well as the results obtained from trial timber surveys are also included. The method appears to work well under the conditions described. However, care must be used to avoid erratic results resulting from outliers in the ratios of v_i/p_i.

10 LANGLEY, Philip G.
1978. Remote Sensing in Multi-Stage, Multi-Resource Inventories. Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 205-208.

Theoretically, multi-stage, multi-resource inventories which estimate all parameters to the same level of precision by means of common plot structures and intensities are impossible. By means of remote sensing, however, variations in multi-stage sampling designs are possible wherein multi-parameter estimates can be made to a reasonable degree of precision.

11 LEARY, Rolfe A.
1976. Interaction Geometry: An Ecological Perspective, U.S.D.A. For. Serv. Gen. Tech. Rept. NC-22, 8 pp.

A new mathematical coordinate system results from a unique combination of two frameworks--the phase plane and coaction cross-tabulation. It may be used for analysis and synthesis.

12 LETTENMAIER, Dennis P. Keith William Hipez and A. Ian McLeod. 1978. Assessment of Environmental Impacts Part Two: Data Collection. Environ. Mgmt. 2(6):537-554.

Intervention analysis is a relatively new branch of time series analysis. The power of this technique, which gives the probability that changes in mean level can be distinguished from natural data variability, is quite sensitive to the way the data are collected. The principal independent variables influenced by the data collection design are overall sample size, sampling frequency, and the relative length of record before the occurrence of the event (intervention) that is postulated to have caused a change in mean process level.

For three of the four models investigated, data should be collected so that the post-intervention record is substantially longer than the pre-intervention record. This is in conflict with the intuitive approach, which would be to collect equal amounts of data before and after the intervention. The threshold (minimum) level of change that can be detected is quite high unless sample sizes of at least 50 and preferably 100 are available; this minimum level is dependent on the complexity of the model required to describe the response of the process mean to the intervention. More complex models tend to require larger sample sizes for the same threshold detectable change level.

Uniformity of sampling frequency is a key consideration. Environmental data collection programs have not historically been oriented toward data analysis using time series techniques, thus eliminating a potentially powerful tool from use in many environmental assessment applications.

13 LEVIN, S. Benedict, John T. Everett, and Jan Van Roessel. 1973. Accelerated Resource Mapping and Map Updating for Latin America by Combined Use of Airborne Radar and Satellite Imagery. Panam. Symp. on Remote Sensing, 1st, Proc. Panama City, Rep. of Panama. Apr 27-May 2, 1973, p. 65-76. Sponsored by U.S.G.S. Earth Resour. Obs. Syst. (EROS) Program, Washington, D.C. 1973.

The combined use of two new remote sensing capabilities now make it possible to achieve within months the superior map base and natural resource information that formerly required decades of difficult ground surveying, and much larger expenditures, especially for relatively inaccessible terrain. These capabilities are of particular potential value for the developing regions of Latin America - where mineral resources, timber and other forest products, agricultural and grazing lands, water, highway and railroad routes, harbors, etc., await delineation and study. It

is shown that the carefully planned and integrated use of ERTS and SLAR can provide a powerful system for the acquisition of geographic information in both the more developed and the less developed regions of Latin America. The cost of acquiring, mapping, and analyzing such information can be nominal in relation to the benefits deribable. Moreover, the planning and execution of cooperative programs can yield substantial savings in time and money.

14 LEWIS, Clifford E.
1977. Inventory and Forage Capability Determination. In Proceeding of the Coop. Forest Mgmt. Tech. Training Session, Aug. 15-19, 1977. Gainesville, FL. p. 9-19.

Most southern forests produce forage in the understory that can be used by cattle and wildlife. This is especially true in the pine-wiregrass type of Florida. Some basic requirements of cattle and the ability of wiregrass forage to meet these requirements are discussed. A technique for the inventory of this forage resource provides basic information for determining cattle stocking rates.

15 LEWIS, Clifford E.
1977. Principles and Status of Integrated Management from the Range Viewpoint University Florida, Resources Report 4:26-34. 34 p.

Good opportunities exist in the South for simultaneously producing wood, wildlife, and cattle. By using some techniques developed through research, integrated management can be successful, and economic evaluations indicate potential profits.

16 LIANG, Tung and Wen-Yuan Huang.
1975. Dynamic Model for Water and Related Land Resource Planning. Univ. of Hawaii, Water Resour. Bull. 11(1):33-48.

A mathematical programming model with the capacity to check multiple resource demand and supply compatibility over many time periods was developed for the solution to this type of problem. The characteristics of natural resource supply and the demand of activities were utilized to reduce the number of time periods and to minimize the loss of the dynamic reality of the problem. Reduction in the number of time periods extended the capability of the model to the solution of complex resource planning problems without oversimplification.

17 LIANG, Tung, Wen-Yuan Huang, and I-Pai Wu.
1974. Dynamic Water and Related Land Resource Planning Model: Its Application to a Hawaiian Small Water System. Hawaii Univ. Water Res. Cent. Tech. Rept. 81: 55 p.

A mathematical programming model with the capacity to check multiple resource demand and supply compatibility over many time periods was developed as a solution to the problem of planning an optimal system of activities. The characteristics of natural resource supply and the demand of activities were utilized to reduce the number of time periods and to minimize the loss of the dynamic reality of the problem. Reduction in the number of time periods extended the capability of the model in solving complex resource planning problems without over-simplification. A matrix generator capable of dividing time span according to resource characteristics and IBM-MPS output compatible matrix for LP optimization was developed.

18 LIEGEL, Leon H. and del Toro, Gabriel A.
1974. An Intensive Natural Resources Inventory Aids Land Use Planning and Resource Management in Puerto Rico, In Fall Mtg., Am. Soc. Photogramm., Washington, D. C., 1974, Proc.: Falls Church, VA., Am. Soc. Photogramm., p. 57-65.

19 LIEGEL, Leon H., and del Toro, Gabriel A.
1974. Merits of Conventional Aerial Photography in an Intensive Natural Resources Inventory in Puerto Rico, In Ann. Mtg., Am. Soc. Photogramm., 40th, St. Louis, 1974, Proc.: Falls Church, VA., Am. Soc. Photogramm., p. 178-191.

20 LILLESAND, Thomas M. and Ralph W. Kiefer.
1979. Remote Sensing and Image Interpretation. John Wiley & Sons, Inc., NY, NY. 640 p.

Textbook covering: Concepts and Foundations of Remote Sensing; Elements of Photographic Systems; Introduction to Airphoto Interpretation; Airphoto Interpretation for Terrain Evaluation; Photogrammetry; Radiometric Characteristics of Aerial Photos; Aerial Thermography; Multispectral Scanning and Spectral Pattern Recognition; Microwave Sensing; and Remote Sensing from Space.

21 LINDSEY, Alton A.
1958. Field Efficiencies of Forest Sampling Methods. Ecology 39(3):428-444.

The Bitterlich method was shown to be more efficient in sampling density and basal area. Seven methods were compared, including varying the following: square, strip, circle and quarter.

22 LINTZ, Joseph Jr., and David S. Simonett.
1976. Remote Sensing of Environment. Additon-Wesley Pub. Co., Reading, Mass. 694 p.

Multidisciplinary reference and textbook describing the technique of remote sensing as applied to natural resources.

23 LLAVERIAS, Rita K.
1970. Remote Sensing Bibliography for Earth Resouces 1966-67. U.S.G.S. Water Resources Div. Rept. No. USGS-WD-70-001. 136 p.

This is the second in a series of bibliographies on remote sensing of earth resources applications. The subject matter coverage is extended from the earlier more restricted area of hydrology to the broader field of earth resources, but the emphasis on water resources applications remains. Citations of literature appearing in 1966-1967 are presented from such fields as agriculture, forestry, geography, geology, hydrology, meteorology, oceanology, range management, and urban planning, to the extent that they relate to water resources. For the 412 citations, indexes are provided for personal and corporate authors; the subject term index contains three descriptors for each item.

24 LOETSCH, F., and K. E. Haller.
1973. Forest Inventory - Volume 1, 434 pp. BLV Verlagsgesellschaft, Munich, Germany.

The text is a handbook on the theoretical background and practice of modern forest inventory. It includes statistics of forest inventory and use of aerial photographs.

25 LOETSCH, F., F. Zohrer, and K. E. Haller.
1973. Forest Inventory, Volume 2, 469 pp. BLV Verlagsgesellschaft, Munich, Germany.

This is the second volume of a two-volume textbook on Forest Inventory. It combines many of the heterogeneous elements as statistics, photo interpretation, forest mensuration and electronic data processing under the aspect of forest inventory methodology.

26 LUKES, G. E.
1977. Integration of Optical Power Spectrum Analysis and Projective Sampling for Land-Use Change Assessment. Photogramm. Eng. and Remote Sensing. 43(6):750-751.

Analytical procedures that provide an automated technique for locating specified terrain locations in an aerial photograph hae been used to assess significant changes in land use imaged by sequential aerial photography. Land-use patterns imaged in aerial photography display distinctive optical power spectra which can be electronically sampled to automatically classify the pattern. Projective sampling algorithms were incorporated into the digital control system of the Recording Optical Spectrum Analyzer. Three sets of photography taken of an expanding urban area over a 130 year period were sampled rigorously accounting for camera scale, position, and orientation, and then analyzed for significant change in land use patterns. Examples of optical power spectra for various land use patterns and the results of the change assessment experiment will be presented. Advantages and limitations of optical power spectrum analysis for this application will be cited.

27 LUND, H. Gyde.
1974. So We Know What We Have--But Where Is It? Proc: Monitoring The Forest Environment Through Successive Sampling, SUNY, Syracuse, NY, pp. 133-141.

The Bureau of Land Management is currently using a double sampling scheme in its extensive forest inventories of the national resource lands. The first sample comes from photo interpretation. Photo points are permanently marked on the photos and USGS quad maps. The interpreted information is stored on magnetic tape along with the universal transverse mercator coordinates of each point. Heretofore the only use we have made of the photo file is to provide a sampling frame for field observations (approximately one out of every ten photo points become a field plot).

This paper describes the regression procedures we are investigating to relate field information back to the photo file.

28 LUND, H. Gyde.
1974. The BLM National Resource Lands Forest Inventory. In Inventory Design and Analysis, p. 334-345. Ed. W. E. Frayer, George B. Hartman, and David R. Bower: Soc. Am. For., Wash., D.C.

Describes the extensive forest inventory being carried out in the public domain.

29 LUND, H. Gyde.
1975. 3P Sampling: An Annotated Bibliography, U.S.D.A. For. Serv., Northeast Area State and Private Forestry, Upper Darby, PA, 25 p.

Contains 77 major publications relating to 3P Sampling.

30 LUND, H. Gyde.
1978. In Place, Multiple Resource, Inventories at Budget Prices. In Resource Inventory Notes. BLM 13, U.S.D.I. Bu. of Land Mgmt., p. 1-7.

The procedures outlined take advantage of the speed and low cost of the extensive inventory and the inplace utility of mapped areas for intensive inventories. The system described in this paper uses the advantages of several types of inventories. At best it will provide a firm resource foundation and a means of prioritizing areas where additional inventories are needed.

31 LUND, H. Gyde.
1978. Multiple Resource Inventories in the United States. Proc. National Forest Inventory. IUFRO, Bucharest, Romania, June 1978. 60-67.

The need for multi-resource information for management decisions is presented. One of the ways of collecting this data is through integrated inventories. Advantages and disadvantages of integrated efforts are outlined. In addition, review of present and probable future multi-resource inventory systems in the United States is presented.

32 LUND, H. Gyde.
1978. Type Maps, Stratified Sampling and P.P.S. Resource Inventory Notes, BLM 15. U.S.D.I., Bu. of Land Mgmt. p. 1-14.

Step by step instructions are provided for using stratified sampling and probability proportional to size (P.P.S.) in resource inventories. This method is useful when sampling type islands from type maps is desired.

33 LUND, H. Gyde.
1979. Uniformly Distributing Samples within a Type Island. U.S.D.I. Bu. of Land Mgmt., Resource Inventory Notes, BLM 22:13-20.

This paper describes a procedure and gives formulas for uniformly distributing sample plots throughout a stand, type island or map polygon. A procedure using equilateral triangles is suggested.

34 LUND, H. Gyde and Matt Kniesel, Jr.
1975. Multiple Resource Inventory System. Proc: Systems Analysis and Forest Resource Management, Unit. of Georgia. Athens, GA, pp 433-441.

In a trial study in Colorado, the Bureau of Land Management successfully incorporated a combination wildlife, range, and watershed survey into its extensive forest inventory program. Photo points, interpreted during the forest inventory, were restratified on wildlife and range criteria. These points were sub-sampled with field plots and estimates of herbage production, ground cover types, erosion condition classes, and deer-days use were obtained. Area statistics were generated, and field prediction equations were developed. The cost of this multiple-resource inventory system was comparable to the cost of other survey methods currently being used by the Bureau.

35 LUND, H. Gyde, V. J. LaBau, P. D. Ffolliott, and D. W. Robinson.
1978. Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop: U.S.D.A. For. Serv., Gen. Tech. Rept. RM 55, 482 pp.

The proceedings of the workshop containing over 70 papers on resource information needs, present inventory methodology, land classification systems, remote sensing, design considerations, data processing and information retrieval systems and state-of-the-arts papers on multiple resource inventories.

36 LUND, Herluf Gyde.
1970. Aerial Photography for Interpreting Forest Understory Vegetation. MS Thesis, Univ. of Washington, 88 p.

Two studies in hardwood forests attempted to determine (1) how accurately understory height and density could be determined from aerial photographs, (2) what effect characteristics of photography have on interpretability and accuracy of measurement, and (3) what photographic specifications and techniques produce the most useful interpretations. Individual height measurements were not always correlated with correponding ground truth, but a reasonable number of measurements could establish mean height within $\pm$ 2.5 feet.

37 LUNDEEN, L. J.
1975. Resource Allocation Analysis and Land Use Application. In Systems Analysis and Forest Resource Management; Proceedings Workshop by SAF, Univ. of Georgia, Athens, p. 48-56.

Resource Allocation Analysis (RAA) is a set of computer-aided analytical tools built around a linear programming algorithm. The RAA is a multi-resource optimization technique designed specifically for use on natural resource and "wildland" management planning problems. The three main components of RAA are a data processor and matrix generator, a large linear program code for allocation analysis, and a series of output display programs. Up to the present time, RAA has been used in the development of about 40 land use plans on National Forests throughout the United States.

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01 MACDOUGALL, Edward B. and Charles E. Brandes.
1974. A Selected Annotated Bibliography on Land Resource Inventory and Analysis for Planning, Penn. Dept. of Environ. Resources, Harrisburg, 36 p.

02 MACPHAIL, Donald D.
1971. Photomorphic Mapping in Chile: Photogramm. Eng., 37(11): 1139-1148.

In 1966 a program to map the agricultural regions of Chile began around "photomorphic" areas. Each has a broad, repetitive pattern which forms the composite image of the fields and fence lines, the system of drainage, and the tone ranges of land use, rock outcrop, soil moisture, and vegetation. Descriptive and identifying information consists of recognizing the surficial and photographic features with respect to continuity, uniformity, tonal quality, and apparent form. The core area of Chile between the Aconcagua Valley and Puerto Montt was mapped by photomorphic area. Random samples (25 km^2) consisted of 2 percent of each photomorphic type. Sample maps gave information not available from other sources: detailed land use, land tenure, and related farm size. Tests showed strong correlations with other important landscape features. This method may provide a useful approach to land inventory via remote sensing.

03 MACINTOSH, E. E.
1978. A Methodology for Environmental Impact Analysis in Predesign and Planning Studies. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, Victoria, British Columbia, Ecological Land Classification Series #7. 319-324 p.

A methodology is presented for conducting environmental planning and assessment studies. Emphasis is placed on discussing techniques for managing the group's activities and structuring of the team.

04 MADER, Donald L.
1974. Sampling Problems Related to Spatial Variation in Soils and Other Aspects of the Physical Environment of Forest Ecosystems. In Monitoring Forest Environment through Successive Sampling. State University of New York, College of Environmental Science and Forestry p. 187-202.

Information on the variability of forest soils and the forest stand environment is needed in order to evaluate the probable success of particular sampling designs or systems to discriminate differences between areas being studied. Appreciation of the degree of variability in established soil and vegetational units which are often used as a basis of sample unit selection is also desirable. Thus, we may well raise the question of where we stand in regard to such information, the problems associated with obtaining and using it, and those areas of information most in need of study.

05 MARSH, W. M.
1978. Environmental Analysis: for Land Use and Site Planning. McGraw-Hill, NY, NY. 292 p.

Textbook covering spatial organization, slope and topography, soils and drainage, vegetation, flood plains, sources and acquisition of environmental information, applications of environmental analyses, communication of environmental information and special topics including landslide-hazard mapping for local land use planning, remote-sensing applications in water quality management and elements and methods of impact assessment.

06 MARSHALL, John A., and Glenn H. Deischman.
1976. Computerization of Data Handling for Long-Term Research Plots. Northwest Science, 50(4):231-235.

Tree and stand development data from long-term research sample plots in northern Idaho have never been utilized as fully and effectively as they might have been because of time required to select, check, and arrange all appropriate portions for analysis. This report describes development of automated data processing procedures that make access to desired data easy and inexpensive and also provide editing capabilities, improved insurance against data loss, and printed field forms keyed to each plot for recording the next remeasurement.

07 MCCORMACK, R. J.
1970. The Canadian Land Inventory - Land Capability Classification, Classification for Forestry. Report No. 4, Dept. of Regional Economic Expansion, Ottawa.

This publication describes the Canada land inventory, land classification system, basis of classification, capability classes, and guidelines for mapping.

08 MCCORMACK, R. J.
1970. The Canada Land Inventory. The Canada Land Inventory Rept. No. 1, Dept. of Regional Economic Expansion, Ottawa.

The publication describes areas covered by the Canada Land Inventory, technical background, what the inventory provides, recent history, and its objective and scope.

09 MCCURDY, Dwight R. and N. S. Hartman.
1974. A Resource Inventory Method to Support Land Use Planning, South. Ill, Univ. Dept. For. Publ. 14, 43 p.

10 MCCURDY, Dwight R. and Charles C. Myers.
1978. Methodologies for Designing Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A. Fort Collins, CO. p. 150-154.

To design an integrated resource inventory to support land use allocation, the data needed to determine suitability of a tract for the selected uses must be stipulated. Several techniques for allocating priorities on these data for inclusion in the inventory are discussed.

11 MEADOWS, John, Bruce Bare, Kenneth Ware, and Clark Row.
1975. Systems Analysis and Forest Resource Management. Systems Analysis Working Group SAF at University of Georgia, Athens. p. 446. (Proceeding of the Workshop)

An overview of Systems Analysis, Multiple-Use and Land-Use Planning, Timber Management, Harvesting and Transportation, Fire, Data Management and miscellaneous subjects are discussed.

12 MENDENHALL, William, Lyman Ott and Richard L. Scheaffer.
1971. Elementary Survey Sampling, Wadsworth Publishing Company, Belmont, California 247 p.

An introductory text on design and analysis of sample surveys intended for students of business, social sciences or natural resource management.

13 METCALF, Melvin E.
1974. Setting Objectives for Forest Inventories. In Inventory Design and Analysis Proc., Workshop Sponsored by the Inventory Working Group. SAF, Colo. State Univ., p. 1-3.

Clearly stated objectives are a primary requisite for satisfactory forest inventories. The development of such objectives requires understanding of the types of decisions to be made, the factors involved, and the manner in which those factors are to be evaluated.

14 METEER, James W.
1966. A Conference on Continuous Forest Inventory. Proceedings of the Conference on Continuous Forest Inventory. May 1965. Michigan Technological Univ., Houghton, MI. 296 p.

Topics of the conference include: principles and planning, programs and machine work application of results, errors, sampling, soil-site analysis, and policy and forest control. Each topic is covered by several different papers from individual authors.

15 MILLER, J. M. and A. E. Belon.
1974. A Summary of ERTS Data Applications in Resource Inventories, Environmental Surveys and Land Use Planning in Alaska. In Proceed. Int. Symp. on Remote Sensing of Environment. 9th (3):2113-2138.

ERTS has proven to be an exceedingly useful tool for the preparation of urgently needed resource surveys in Alaska. For this reason, the wide utilization of ERTS data by federal, state and industrial agencies in Alaska is increasingly directed toward the solution of operational problems in resource inventories, environmental surveys, and land use planning. Examples of some applications are discussed in connection with surveys of potential agricultural lands; mapping of predicted archaeological sites; permafrost terrain and aufeis mapping; snow melt enhancement from Prudhoe Bay roads; geodogic interpretation correlated with possible new petroleum fields, with earthquake activity, and with the plate techonic motion along the Senali fault system; hydrology in monitoring surging glaciers and the breakup characteristics of the Chena River watershed; sea-ice morphology correlated with marine mammal distribution; and coastal sediment plume circulation patterns.

16 MILLER, Robert Leo.
1974. A Basic Model for Economic Analysis of Production on a Multiple-Resource Forest Watershed Unit. Ph.D. Diss., Colorado State University, 132 p.

An economic joint product model was developed in this study for current decision-making needs in management and in research in multiple-resource forest watershed management. The approach taken was to begin with general economic principles, and to form the model with production relationships as they exist, rather than to try to apply the traditional joint product model. The resulting model is simpler than traditional formulations, yet has the advantage of handling several outputs graphically, and avoids problems experienced in previous attempts to apply the traditional model.

The model is adaptable to several management questions, and can be viewed as one of family of similar models that can be developed for a wide range of practical management issues at the basic production unit or response unit level. Other uses are demonstrated, in improving cost-effectiveness in extra-market decisions, analyzing economics of practices within systems, and determining research priorities.

17 MINOR, Charles.
1978. Panel 1 - Information Requirements for Resource Management: Moderator's Comments. In Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For., Serv., U.S.D.A. Fort Collins, CO. p. 4.

This panel has the very necessary task of establishing the information needed for management of the multitude of resources and resulting problems facing the modern land manager. Before an inventory is designed and conducted we must determine information needs and objectives. Prior analysis and planning might do away with some of the "since we're on the ground we might as well measure it-syndrome!"

18 MITCHELL, W. B., S. C. Guptill, K. E. Andreson, R. G. Fegeas, and C. A. Hallam.
1977. GIRAS: A Geographic Information Retrieval and Analysis System for Handling Land Use and Land Cover Data. U.S.G.S. Prof. Pap. 1059, 16 p.

The U.S. Geological Survey is currently producing land use and land cover maps and associated overlays (e.g., political units) for the United States. These maps are being digitized, edited, and incorporated into digital data base. The data will be available to the public in both graphic and digital form, and statistics derived from the data will be published. To accomplish these tasks the Geographic Information Retrieval and Analysis System (GIRAS) has been designed and developed. GIRAS is designed to accept digitized input, provide comprehensive editing facilities, product cartographic and statistical output, permit retrieval and analysis of data, and exercise data base management tasks. The editing and output procedures are currently operational and utilize an arc segment, polygon approach in a production mode. The system incorporates facilities for gridding the polygon data to make it compatible with grid-based data sources. Current system development is focused upon an interactive data base to enable immediate retrieval and display of map information. Users will be able to search for either locations or attributes and display results in a graphic or tabular form.

19 MODIFIED ECOCLASS COMMITTEE.
1977. Modified ECOCLASS--A Method for Classification of the Basic Ecosystems. U.S. For. Serv., Region 2, Region 3, and Rocky Mtn. For. and Range Exp. Stn., Ad Hoc Committee, Mimeo: 87 p.

ECOCLASS - A Method for Classifying Ecosystems, presented in January, 1973, presents an acceptably sound generalized concept of a method for classification of the basic ecosystems. However, it was determined that each of the component systems and the hierarchy developed under each in ECOCLASS were not entirely pure in the sense of relating to a vegetation system, a land system, or an aquatic system. At various levels in the hierarchies, some individual categories were hybrids representing integrated classes either within or between the systems.

A hierarchy is an organization of components into orders and ranks each subordinate to the one above it. At any point within the hierarchy individual components must admit to both aggregation into larger more generalized orders and disaggregation into smaller more specific orders. In other words, it allows a logical, systematic route of travel both up and down through the hierarchy.

20 MOLLOY, Martin W.
1973. Earth Resource Surveys from Space. Symp. on Remote Sensing, Proc. Pretoria. S. Afr., May 3-5, 1972, p. 1-8.

The NASA program for the survey of the environment and the earth's resources is reviewed. This includes the current aircraft program as well as the imminent unmanned Earth Resources Technology Satellites and the Earth Resources Eaperiment Package to be flown in the manned Skylab spacecraft in 1973. Surveys of the earth by these means should provide data for global monitoring and inventories and enable the development of physical models which could be employed for the prediction of environmental changes and the conservation of natural resources.

21 MONTANA AGRICULTURAL EXPERIMENT STATION.
1974. Natural Resource Inventory Checklists. Sections 1-5. Montana Agricultural Exp. Stn. Research Report 50, Bozeman, MT, Various paging.

This checklist is the result of a literature review and consultation with natural resource experts. The purpose of this checklist is to stimulate ideas, conversation, and an awareness of the complexity of the environment, and to help identify local critical issues and to select those details needed in natural resource inventories. One considers such topics as: (1) Soil survey; (2) soil-air resources relations; (3) soil-water relations; (4) soil plant/animal ecology relations; (5) soil-geology relations; (6) soil minerals inventory; and (7) soil pollution inventory. Section two covers vegetation. Section three considers such topics as: (1) Precipitation; (2) frost inventory; (3) winds inventory; (4) air temperature probabilities; (5) humidity; (6) atmospheric pressure; (7) air mass occurrence; (8) air inversions; (9) storm inventory; (10) evapotranspiration potentials; (11) solar inventory; and (12) air quality. Section four: (1) A watershed water budget; (2) chemical water quality; (3) visual and aesthetic examination; (4) macrobiological inventory; (5) biological inventory; (6) physical water quality; (7) soils relations; (8) geology relations; (9) water-air resources relations; (10) water pollution inventory; (11) wetlands

area; (10) lakeshore and watercourse frontages; (13) water-anomal relations; and (14) water-plant relations. Section five on plant/animal ecology includes such topics as: (1) Plant ecology; (2) animal ecology; (3) mapping vegatation; and (4) plant-animal relations. A wall chart capsule Info. Series No. 2. summarizes the checklists.

22 MONTANA DEPT. OF NATURAL RESOURCES AND CONSERVATION.
1973. A Resource Inventory Method for Land Use Planning in Montana. Montana Dept. of Natural Res. and Conservation. 78 p.

The primary objective of this study was to develop and field test a method of natural resource inventory and analysis for land use planning. This objective has been approached from the standpoint of two potential applications: (1) to provide general inventory procedures which local planning agencies can use and modify as a means of identifying and protecting important natural and cultural values, and (2) to identify and plan for areas of critical environmental concern to the state as a step in the formulation of a state planning process.

23 MONTANARI, John H. and Bill O. Wilen.
1978. Techniques Developed and Presently Being Used to Conduct the National Wetlands Inventory Project. Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A. Fort Collins, CO. p. 192-198.

The National Wetlands Inventory Project has attempted to use existing data, systems and techniques when they met the Project's goals and objectives. When they did not, new systems and techniques were developed to meet not only the Project's present but also its future goals and objectives.

24 MOON, D. E.
1978. A Comparison of Four Levels of Soil and Ecological Mapping in Forested Watersheds. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. 331-334 p.

The British Columbia Ministry of Forests has long recognized the need for planning the use and development of forested land. They have defined four levels of planning: regional, management unit (Public Sustained Yield Unit), sub-unit (watershed), and operational (cut block). Attempts by Ministry of Forests personnel to use existing reconnaissance level soil and biophysical inventories for sub-unit planning have met with limited success, primarily because existing inventories were conducted at scales and using map units inappropriate to this level of planning. For the past three years, the British Columbia Pedology Unit of the Land Resource Research Institute, Agriculture Canada (L.R.R.I.) has been cooperating with the Forest Service, British Columbia Ministry of Forests to produce basic resource inventories for use in the Resource Folio Planning System at the sub-unit planning level. This cooperation (specifically with the Vancouver Forest District) has led to a change in both the mapping units used and in the interpretations of these units requested by the Forest Service. This paper will outline our present program of soil and ecological mapping which compares four levels of inventory in the Mill Creek and Woodfibre Creek watersheds located 48 km north of Vancouver.

25 MOORE, William H. Thomas H. Ripley and Jerome L. Clutter. 1960. Trails to Determine Relative Deer Range Carrying Capacity Values in Connection with the Georgia Forest Survey. In Proc. of the 14th Annual Conference, SE Assoc. of Game and Fish Commissioners. Biloxi, Mississippi, p. 98-104.

The Forest Survey is part of a continuing inventory of forest resources conducted by the Forest Service to provide accurate, up-to-date information for the management of the nation's timber. Developments in survey sampling methods, used for the first time in Georgia, provided an opportunity to sample other attributes of forest land, especially game habitat. Laurens County, Georgia, was selected to test sample for occurrence and quality of woody browse. This involved frequency sampling of 20 cylindrical milacre plots, 4½ feet high on a 1½-chain square traverse for the presence of woody browse at each sampling location. Individual browse species were sorted into preference classes, and the distributions were analyzed for differences between major forest types, stand sizes and site indices.

The three major types tested (slash pine, pine-hardwood, water oak-gum) differed significantly in distributions of browse. Partitioning indicated that major and highly significant differences existed between pine and the two hardwood types, but there was no significant differences between hardwood types. Other analyses included tests and detection of significant difference in browse distributions on the basis of stand size and site.

Although the data do not give a quantitative estimate of the browse present, results show that this type of sampling gives a sensitive measure of occurrence and relative qualitative difference in communities. Further, these data should suggest silvical practices which would provide high, long-term yields of forage.

26 MORRIS, M. J.
1973. Estimating Understory Plant Cover with Rated Microplots. U.S.D.A. For. Serv. Res. Pap. RM 104. 12 p. Rocky Mtn. For. and Range Exp. Stn., Fort Collins, CO.

Plant cover measurements are used to detect changes caused by grazing, fire, and other factors. Tests on both high and low production sites of 17 areas in the West indicate that trained range personnel rate small plots similarly in respect to the area occupied by aerial and basal plant cover. Plots used ranged from 1/8 square inch to 8 square inches. Equal area rectangles and circles were used. All are well suited for plant cover, although the smaller sizes tended to be slightly more precise.

27 MORRISON, Donald F.
1976. Multivariate Statistical Methods. 2nd ed. 415 p. McGraw-Hill, Inc., New York. 361 p.

Textbook covering elementary statistical concepts, matrix algebra, samples from the multivariate normal population, test of hypotheses of means, multivariate analysis of variance, independence of sets of variates and canonical correlation, and the structure of multivariate observations.

28 MOSER, John W. Jr.
1976. Illustration of a Generalized Data Base Management System for Maintaining Compartment Records: Proceedings, Resource Data Management Symposium. SAF August, Purdue University, West Lafayette, Indiana, 39-52 p.

System 2000, a generalized data base management package, is employed to define, populate, query and update a data base consisting of descriptive and operational data associated with the traditional subdivisions of a forest property. Emphasis is directed toward managerial personnel who are not experienced programmers.

29 MOSER, John W., Jr.
1978. Data Processing Systems: Moderator's Comments. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A. Fort Collins, CO. p. 317-318.

To avoid hazards, the implementation of successful integrated inventories requires integration of the planning effort starting with the objectives and design specifications and continuing through the computational phase.

30 MOSER, John W., Jr., ed.
1976. Proceedings Resource Data Management Symposium. Sponsored by Society of American Foresters, Systems Analysis Working Group and Inventory Working Group. Cooperative Extension Service, Purdue Univ., West Lafayette, IN. 153 p.

Topics discussed in the review are: the use and importance of information in managerial decision making, illustrations of generalized data base management systems and geographical information systems, and examples of both public agency and private industry utilization of these systems.

31 MOWER, Roland D.
The Inventory and Distribution of Water and Associated Land Resources in the Garrison/Devils Lake Region of North Dakota: An Application of Resource Data Acquired by ERTS. Research Project Technical Completion Report, Office of Water Research and Technology, U.S.D.I., Washington, D. C. May 1978. 26 p.

This study was designed to inventory and spatially analyze water and land resources in the Garrison/Devils Lake Region of North Dakota utilizing resource data acquired by ERTS. Preliminary land use studies in Mercer County involved the interpretation of black and white, and color infrared (CIR) aerial photographic imagery (1:24,000), a LANDSAT color composite image (1:250,000), a Mead Digit Graphics Generator (DGG) image (1:225,000), and a Mead Digital Laser Printer (DLP) image (1:6000,000). Subsequent land use/land cover research in the Devils Lake Basin has included the interpretation and analysis of LANDSAT computer compatible tape (CCT) data using both the General Electric IMAGE 100 Multispectral Analysis System and the Bendix Multispectral Data System (M-DAS). Collaboration between Bendix Aerospace Systems Division and the North Dakota Regional Environmental Assessment Program (REAP), with Sensing (UNDIRS), produced a land cover map at a scale of 1:500,000

for the State of North Dakota. The results of this study, in both tabular and graphic format, have been made available to various planning agencies in North Dakota and to all special task force units established by the Devils Lake Committee.

32 MOYSEENKO, H. P., J. L. Woodall and S. A. Woodall.
1977. The Balanced Ecogeographic Information System: A Vehicle for Data Collection Systematization and Dissemination. In Classification, Inventory and Analysis of Fish and Wildlife Habitat; Symposium, U.S.D.I., Fish and Wildlife Service. FWS/OBS-78/76. p. 569-592.

The data base is a collection of cross-referenceable manual and automated files. The manual files are designed to provide efficient access to lengthy and complex types of data. The computer programs comprise more than 12 modules which can be applied flexibly to many data processing needs. These programs have particular utility for collecting, managing, and displaying ecogeographical data. In addition to providing methods for data entry, update, and correction, the programs offer capabilities for highly selective search and retrieval, report production, and automated map generation. They permit record-by-record handling of data and accessing combinations of single and cross-referenced fixed and variable length records. The system has the potential to link up with other ecological data bases, thus making it possible for a wider spectrum of data to become centrally accessible. The information system serves not only as a storage and retrieval medium but also as a catalyst for the efficient flow of data from the field to the decisionmakers.

33 MYERS, C. C., B. F. Hoffman, and A. R. Patunoff.
1973. A Computerized Inventory System. Jour. of Forestry. 71(3):163.

In its simplest form the inventory system consists of: (1) an input form that provides for efficient field collection of data for later transferral to punch cards, (2) a Fortran IV computer program that incorporates mathematical and logical routines to get from input to output; and (3) a computer output sheet that presents the desired information in readable form.

34 MYERS, Charles C.
1974. Inventory Environmental Quality. In Proceedings; Monitoring Forest Environment through Successive Sampling, June 74. State University of New York, College of Environmental Science and Forestry. p. 153-169.

Inventorying environmental quality presents numerous problems in measuring, sampling and interpreting data. An environmental quality inventory can provide information for evaluating and ranking possible projects for designing environmental programs, can provide information on the amount of each type of work that is necessary and the comparative benefits which could be achieved by each project or type of improvement.

35 MYERS, Victor I., and A. A. Klingebiel.
1974. An ERTS-Based Land Resource Inventory for Mexico's National Water Study. Soil Conservation 40(4):18.

Study of potential land use map of Mexico. Maps were based on interpretation of available soil and related resource data and on the use of ERTS imagery.

N

01 NAVON, Daniel.
1978. Operational Forest Management Planning Methods: Proceedings, Meeting of Steering Systems Project Group, International Union of Forestry Research Organizations, Bucharest, Romania, June 18-24, 1978. Gen. Tech. Rept. PSW 32, 117 p., illus. Pacific Southwest Forest and Range Exp. Stn., For. Serv., U.S.D.A., Berkeley, CA.

These 14 papers were submitted to a conference of Project Group P4.07 Division IV, International Union of Forestry Research Organizations. Topics discussed included the uses of simulations, analytical techniques, and mathematical programming techniques in land management planning, reforestation programs, intensive forestry, timber management and production, tree growth, wood transportation, and budgeting.

02 NELSON, DeVon, Grant A. Harris, and Thomas E. Hamilton.
1978. Land and Resource Classification - Who Cares? Jour. Forestry 76(10):644-646.

Increasingly complicated planning requirements have brought about a renewed interest in land and resource classification. While classification for a single purpose may be relatively easy, providing a system which is suited for several purposes is a complex undertaking. Before we can effectively address the dilemma of unifying classification systems, we must improve understanding of what is involved and provide for effective communication. Foresters because of their multiple-use management responsibilities on wildlands, are in a strong position to take the lead in developing common approaches to the classification problem.

03 NELSON, H. David.
1975. Developing Interactive Computer Graphics for Geographic Information. In Systems Analysis and Forest Resource Management Proceedings Workshop by SAF, Univ. of Georgia, Athens, p. 380-393.

Developing interactive computer graphics for map and attribute manipulation is the objective of a Bureau of Land Management's Oregon Resource Information System (ORIS) project. Maps and descriptive information related to each map entity (point, line or polygon) can be stored, retrieved and manipulated from a graphic terminal by information users (who are primarily resource managers and not skilled in automatic data processing) and displayed as either paper maps or as pictures on a television-like cathode-ray-tube (CRT). Although some capabilities for automated geographic data handling have been achieved and are in use, many needed capabilities have yet to be developed.

04 NELSON, W. C. and J. E. Johnson.
1976. Resource Inventory - Information Management and Monitoring System. N. D. Farm. Res. 34(2):20-22. N.D. Agric. Exp. Station.

RIMS--Resource Inventory, Information Management and Monitoring System--is a computer-based system for collecting, storing, and processing geographically-based data. Land cover, soil associations, and other resource data are being digitized for later retrieval in tables and single and composite maps. An analysis system, RIMS, is being developed to use the data system in analyzing environmental, economic, and demographic effects of natural resource developments. The simulation model is being used to estimate soil loss and water quality relationships to agriculture and environmental-economic-demographic impacts of coal mining.

05 NEW YORK STATE OFFICE OF PLANNING SERVICES.
1972. Land Use and Natural Resource Inventory (LUNR) Classification Manual. Land Use and Natural Resource Inventory of New York State. Albany, NY. Rept. No. NY-OPS-557-672. 24 p.

The manual lists and defines the land use categories in the New York State Land Use and Natural Resource (LUNR) Inventory. The LUNR project is the first of its kind--a statewide inventory land use based on aerial photography and computer tabulation and mapping. The system produces several aids for planners and others who need land use information. Among these aids are aerial photographs, plastic overlay maps coded to show 130 land use characteristics,

computer tabulations of land use statistics for each square kilometer of the state's surface, and computer maps presenting the information graphically. The manual defines and codes and symbols used in the 130 categories covering Agricultural, Forest, Water, Residential, Commercial and Industrial, Recreational, Mining, Transportation and Highway uses.

06 NEWELL, J. W. and W. I. Walbran.
1974. The Integrative Value of Specialist Cooperation in a Regional Soil Survey, 10th Trans. Int. Congr. Soil Sci. 2(2):667-675.

07 NEWTON, Carlton M.
1973. Multiproduct Estimation of Volume and Growth Statistics in Forestry Research, Proceedings of the Meeting of IUFRO Subject Group S6.02 p. 201-209.

The problem of estimating not only the current volumes, but also changes in volumes for multiproduct utilization is investigated in light of changing technology. Multivariate sampling with partial replacement (SPR) is presented as a possible solution. The appropriate estimating procedures are given, and the likeliest consequences of their implementation are discussed. It is concluded that when basic, complete tree measurements are taken, multivariate SPR provides an efficient means of estimating, on a per product basis, (1) current volume, (2) actual net growth, (3) apparent net growth resulting from redefinition of utilized standards.

08 NEWTON, Carlton M.
1978. Integrated Broad-Based Forest Inventories with Management Inventories for Small Private Ownerships. Integrated Inventories of Renewable Natural Resources. Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A. Fort Collins, CO. p. 143-146.

A discussion of the need to and potential for, incorporating the results from broad-based forest inventories into the design and analysis of management inventories on small private forest holdings. All too often the two types of inventories are designed and conducted as totally separate efforts. Computer based information systems are considered necessary if broad-based information is to be made easily available to the landowner. Vermont is presented as a case in point.

09 NICHOLS, James D.
1976. Pacific Northwest Resources Inventory Demonstration. Symp. on Mach. Process of Remotely Sensed Data. Purdue Univ., West Lafayette, IN, Jun 29-Jul 1, 1976, Pub. by IEEE , New York, NY, 1976 Sess. PC. p. 10-15.

The Pacific Northwest Land Resource Inventory Demonstration project is being carried out jointly by NASA, the U.S. Department of the Interior (USDI) and Pacific Northwest Regional Commission (PNRC) through the technical capability provided by NASA, U.S.D.I. and contractor support. The project is designed to demonstrate to users from state and local agencies in Washington, Oregon, and Idaho the cost effective role that LANDSAT derived information can play in natural resource planning and management when properly supported by ground data and aircraft data.

10 NICHOLS, James D.
1979. Multi-Stage and Multi-Phase Sampling, U.S.D.I. Bur. of Land Mgmt. Resource Inventory Notes BLM 18, p. 1-5.

Paper describes the difference between multi-stage and multi-phase sampling.

11 NICHOLS, James D., R. A. Harding, R. B. Scott and J. R. Edwards.
1976. Forest Inventory of Western Washington by Satellite Multi-Stage Sampling, In American Society of Photogrammetry, Fall Convention, Seattle, WA, Sept. 1976, Proc.; American Society of Photogrammertry, p. 180-217.

The State of Washington Department of Natural Resources (DNR) has multidisciplinary state-wide governmental and proprietary responsibilities. The DNR obtains and indexes state-wide aerial photography (black and white, color and FCIR) which is used for many purposes including inventory. The DNR, with USDI-EROS Contract No. 14-08-001-12863, developed potential applications for LANDSAT data and is a key participant in developing the joint USDI-EROS, NASA-AMES and Pacific Northwest Regional Commission Land Resource Inventory Demonstration Project, as a part of which the DNR is performing the described forest inventory of Western Washington by LANDSAT multi-stage sampling.

12 NUNNALLY, N. R.
1969. Integrated Landscape Analysis with Radar Imagery: Remote Sensing of Environment, 1(1):1-6.

The hypothesis of this paper is that radar provides a means for delimiting varying associations of physical and cultural phenomena through the outlining image variations in tone, texture, pattern, and shape. It can be demonstrated that image patterns delimited on radar are visually correlated with known, observable variations of physical and cultural phenomena. Although the small scale and limited resolution of the radar prohibit interpretation of fine detail, enough information can be interpreted to basically characterize each of the regions. The value of the approach is that reliable regional categories can be quickly established and characterized; and, if more detailed regional descriptions are desirable, only limited sampling would be necessary to provide the data. Ultimately, the radar technique may well represent a considerable improvement over other approaches to regional generalization from the standpoint of time, cost, comparability, and accuracy.

O

01 O'REGAN, W. G. and L. G. Arvanitis.
1966. Cost Effectiveness in Forest Sampling For. Sci. 12:406-414.

Cost-effectiveness analysis is demonstrated by the solution of a problem of choice between Bitterlich and circular plot sampling rules in the estimation of total forest basal area and total trees in the forest. The half-width of a 93% confidence interval is chosen as the criterion of effectiveness. A budget function is developed. Plot size and number of plots in a random sample are the inputs that affect cost and effectiveness. Economic theory is used to identify optimum number and size of plots for all parameter sampling rule combinations. Choice in the presence of multiple goals is discussed.

02 O'REGAN, W. G. and Marshal N. Palley.
1965. A Computer Technique for Study of Forest Sampling Methods. Forest Science 11(1):99-114.

An IBM 704 computer program was used to simulate circular plot sampling. Analytical and simulation results are compared for a simple test case. Five mapped forests were run through the similar. Bitterlich point sampling and circular plot sampling were compared. Point sampling was found to be more efficient for total volume and total basal area, but plot sampling was more efficient for total frequency.

03 OBENHAUS, W.
1974. Basic Principles of an Effective Testing of the Environmental Compatibility of Public Measurer. Berichte Uber Landwirtschaft 52(2):263-273.

Testing the environmental compatibility of public measures is an important sub-target of the Federal Government's long-term environment (legal and administrative regulations, programmes, plans, individual measures, and permissive regulations covering activities of other authorities, etc.) be avoided, compensated, or minimized. The presumable effects on the environment should be ascertained and evaluated, optimum solutions for the environment aimed at, and environmental considerations reasonably included in weighing the interests touched upon, as early as possible in the decision-making process. The following five requirements must be met to obtain effective instruments of action: (1) the obligation to consider environmental matters in preparing for decisions; (2) intensive coordination and close cooperation on all administrative levels; (3) guidelines for environmental measures should steadily be made more concrete and precise (ensuring human health and well being, the balance of nature, and careful utilization of natural resources); (4) the early integration of environmental criteria into the decision-making process; (5) methodical, systematic checking using sample procedures.

04 ODERWALD, R. G., J. D. Wellman, and G. J. Buhyoff.
1979. Unequal Probability Sampling with Replacement and without Replacement. U.S.D.I. Bu. Land Mgmt., Resource Inventory Notes. BLM 22 p. 9-12.

Simulated unequal probability samples were drawn from a known population to compare with replacement and without replacement sampling procedures. Results indicate that the gains in variance from without replacement sampling are not sufficient to offset the computational difficulties.

05 OHMANN, Lewis F.
1973. Vegetation Data Collection in Temperate Forest Research Natural Areas. U.S.D.A. For. Serv. Res. Pap. NC-92, 35 pp.

Despite a long history of research natural area preservation by the U.S.D.A. Forest Service and other governmental agencies, ecological baseline data have been gathered for few areas. This report presents a framework, including possible sampling schemes, for ecological baseline data collection by non-professionals working under the consulting supervision of professional ecologists, botanists, or foresters.

06 OLKIN, Ingram.
1958. Multivariate Ratio Estimation for Finite Populations. Biometrika, 45:154-165.

In sample surveys, precision in estimating the unknown mean $\bar{Y}$ of a finite population may be increased by using an auxiliary variable X, which is correlated with Y, and whose mean $\bar{X}$ is known. Two such estimates are ratio and regression estimates. This paper is concerned with the extension of ratio estimation to the case where multi-auxiliary variables are used to increase precision.

P

01 PAGE, E. and R. J. Paul.
1976. Multi-Product Inventory Situations with One Restriction. Operational Research Quarterly, 227(4):815-834.

The problem of maintaining inventories for a number of products where there is a restriction on the maximum inventory investment, or on maximum warehouse space is considered. A method of adjusting the order intervals of the products, the Equal Order Interval Method, is shown in general often to produce significantly better cost solutions to these problems than the well known Langrangian Multiplier Method. Examples are given which demonstrate how the Equal Order Interval Method can be applied effectively and efficiently by heuristics.

02 PAIJMANS, K.
1970. Land Evaluation by Air Photo Interpretation and Field Sampling in Australian New Guinea: Photogrammetria, 26(2/3):77-100.

A survey report, written at the conclusion of preliminary photo interpretation and subsequent field work, presents facts and results. The potential user is not interested in how certain conclusions were reached nor in the limitations and possible shortcomings of the initial photo interpretation. However, for persons concerned with photo interpretation, this kind of information may be useful. For this reason, the author has put in writing his experience obtained in two recently surveyed areas in New Guinea, in the expectation that some of the findings will also be applicable elsewhere in the tropics. The emphasis is on features of the natural landscape.

03 PANTON, W. P.
1970. The Application of Land Use and Natural Resources Survey to National Planning: The Malaysian Experience. World Land Use Surv. Occas. Pap. 9:129-138.

04 PARK, A. B.
1969. Use of Infrared Photography and Satellites for Resource Survey. 24th Soil Conserv. Soc. Amer. Proc. 49-55.

The goals of the U.S. Department of Agriculture's remote program, while ambitious, can be stated briefly:

1. Identify and measure the important food crops.

2. Detect and monitor those factors that affect production.

3. Forecast yield.

The research design assumes the following: Agricultural conditions have attributes that permit them to be identified and measured when viewed from overhead and a record made of the distribution of radiant energy. In many everyday situations, objects are identified by sensing with the human eye and processing this information in the brain. The key to developing an automated remote sensing is determining properties of the material that can be observed from an overhead platform and processed for rapid identification within acceptable error limitations: The characteristics of objects that can be identified remotely by electromagnetic radiation are spatial (shape and texture), spectral (color), temporal (time), thermal (apparent temperature), and polarization. Variations in these characteristics occur both with the angel of observation and the angle and quality of illumination and, in certain cases, intrinsic factors, such as thermal inertia.

These remotely sensed parameters, together with other data, such as geographical location, season, meteorological conditions, etc., can be combined to identify an object under observation. Clearly the more bits of pertinent information that one can use in the sensing system, that is, the greater number of parameters taken into account, the more reliable the identification.

05 PARKER, H. Dennison.
1977. Integration of Operational Remote Sensing Systems with Conventional Inventory Procedures. In Classification, Inventory, and Analysis of Fish and Wildlife Habitat; Symposium. FSN/OBS 78/76. U.S.D.I. Fish and Wildlife Service. p. 543-552.

Remote sensing applications to resource management must be made with data specifications and requirements in mind, since the technology is only a tool. It is best suited to the acquisition of inventory data, although it cannot fill all resource inventory needs. LANDSAT data is appropriate for regional data, but certain

limitations of the satellite data acquisition systems must be understood to take best advantage of them. For more detailed information, aerial color infrared imagery offers numerous advantages. The integration of remote sensing and other types of data must occur in a computer-based geographic information system if future resource management demands are to be met.

06 PAYANDEH, Bijan, and D. W. Beilhartz.
1979. Sample Size Estimation Made Easy. Great Lakes Forest Res. Centre, Canadian Forestry Service, Sault Ste. Marie, Ontario, 19 p. + Appendices.

This paper describes briefly the principles of hypothesis testing and its associated error types, namely, type I and type II errors. The important role that sample size plays in the probability of committing either type of error is pointed out. A procedure that is easy to read and follow is described for determining the required sample size for most experimental purposes. The procedure is outlined first for cases in which the probability of obtaining a confidence interval less than or equal to a specified length or the probability of detecting a false hypothesis is not specified. A similar procedure is given for cases in which the probability of not exceeding a specified confidence interval length or the probability of detecting a false hypothesis is specified.

Several examples are worked out in detail to clarify the procedures of sample size estimation. Three tables provide the required sample size for a wide range of allowable errors and coefficients of variation and for the more commonly used significance levels. It is hoped that most researchers in forestry and related fields will find the procedures outlined here easier to apply and remember than those given in statistical textbooks.

07 PAYNE, S. L.
1951. The Art of Asking Questions. Princeton, Princeton University Press. 237 p.

This book was written chiefly with practical, everyday problems of question wording in mind, it is by no means confined in its usefulness to those people whose job is to construct or ask questions. For the problems the author raises and illustrations and data he brings to bear on these problems pose a number of questions of theoretical interest for specialist in a variety of areas.

08 PEARSON, Henry A., and Herbert S. Sternitzke.
1974. Forest-Range Inventory: A Multiple Use Survey. J. Range Manage. 27(5):404-407.

Successful attempts to incorporate understory herbage and browse measurements into the nationwide Forest Survey are described and evaluated. These attempts were initiated to inventory multiple forest resources--timber, range, wildlife habitat--on a regular basis requiring minimum time and environmental disturbance.

09 PEARSON, Henry A., and Herbert S. Stenitzke.
1976. Deer Browse Inventories in the Louisiana Coastal Plain. J. Wildl. Man. 40(2):326-329.

Deer browse availability and quality in southwest Louisiana were measured concurrently with timber surveys made during a regularly scheduled inventory conducted by the nationwide Forest Survey. The major forest ecosystems of the Southern Coastal Plain were represented in the 3-million-ha area. Loblolly-Shortleaf pine (Pinus taeda-P. echinata) had the most browse cover and longleaf-Slash pine (P. palustris-P. elliottii) the least; burning was more prevalent in the longleaf-slash pine. Bottom land hardwood ecosystems had the best browse desirability ratings. Little regional impact on white-tailed deer (Odocoileus virginianus) populations or timber production was indicated at existing levels of utilization by livestock.

10 PEET, F. G.
1977. A Digital Image Interpretation System for Under $100,000. Information Report, Forest Mgmt. Inst., Canada, No. FMR-X-94.

This report summarizes the approach taken by the Forest Management Institute to the development of a basic, comparatively inexpensive digital image interpretation system based on a minicomputer. Included are a brief background to the problem, the definition and requirements of the system, the hardware description, enhancements and initial software. The report should be of use to those contemplating the purchase of a digital image interpretation system but constrained by cost and other resources.

11 PELZ, Dieter R.
1978. An Automatic Data Processing System for Multiple Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 319-324.

A forest inventory data processing system for multiple resource inventories is described. The system provides the user with information on timber, wildlife food, and wildlife habitat. Timber information includes basal area and volume by diameter class and species and growth predictions. Wildlife food and habitat information includes acorn and nut production, shrub biomass and the number of den trees in the forest.

12 PETERKEN, G. F.
1970. Guide to the Check Sheet for IBP Areas Including a Classification of Vegetation for General Purposes, by F. R. Fosberg. IBP Handbook No. 4, 133 p.

Deals with check sheet of conservation areas, has a specific purpose within Section CT (Conservation of Terrestrial Communities). The Check Sheet is to provide a truly scientific basis for a comprehensive world programme of conserving and safeguarding areas of biological importance. The handbook is intended primarily to assist the surveyors who will be using the checksheet. It describes the aims and operations of the survey and guides surveyors in the selection of sites and filling in of check sheets.

13 PETERSON, R. Max and J. Lamar Beasley.
1978. The Role of Forest Resource Assessments and National Resource Planning. Paper Presented at Eighth World Forestry Congress. 16-28 Oct., Jakarta, Indonesia, FID-I/16-8. 10 p.

During recent years, we have seen more demands placed on the forest and rangelands of the United States as well as other parts of the world. As the population of the world increases, so does the demand for many products and services. Combining the population increases with higher disposable personal income and a rise in gross national products for certain parts of the world (especially the United States), even higher demands are placed on these lands. Projections indicate continued rapid growth in demand for personal goods and services in the decades ahead.

As these demands grow, conflicts among resource uses and users will intensity as efforts to increase the output of products constrain or reduce the quantity or quality of output of others.

The experience of the Forest Service, U.S. Department of Agriculture, in preparing a multiresource assessment of the renewable forest and rangeland resources of the Nation is one example of how a national level effort can serve the purposes of planning to solve problems associated with the management of natural resources. Such assessments provide information for judging

results of ongoing programs. They provide choices for future directions and a framework for relating short-term budget and policy choices to large-range plans and any changes that might be used in national resource planning.

Assessments will not provide all of the information needed for national resource planning, but they will provide the long-range framework needed for such planning activities.

14 PETRUSEWICZ, K., ed.
1967. Secondary Productivity of Terrestrial Ecosystems (Principles and Methods). Proceedings of a Working Meeting Held in Jablonna, Vol. 1 and 2. Institute of Ecology, Polish Academy of Sciences, International Biological Programme PT.

Collection of papers dealing with productivity of terrestrial ecosystems.

15 PETTINGER, Lawrence R.
1978. A Selected Bibliography: Remote Sensing Applications for Tropical and Subtropical Vegetation Analysis. U.S. Geological Survey. Sioux Falls, South Dakota. 47 p.

This bibliography contains 425 citations of selected technical reports, journal articles, and other publications covering the general subject of tropical and subtropical vegetation analysis. Functionally related topics that include vegetation analysis are included for completeness, and citations have been organized under the following subheadings for ease of reference: remote sensing application overviews, vegetation (general), forestry, grasslands/savannah/shrublands, agriculture, land use/thematic mapping, and integrated surveys/multiple resource analysis/land systems. The terms "tropics and subtropics" are used in the widest context to include applications related to a broad range of equatorial environments. The bibliography contains selected citations published between 1924 and 1978. Many foreign language and non U.S.-source items are included.

16 PHILLIPS, William W. and Thomas J. Corcoran.
1978. Wood Transportation Systems - A Spin Off of a Computerized Information and Mapping Technique. In Operational Forest Management Planning Methods: Proceedings, Meeting of Steering Systems Project Group, IUFRO, Gen. Tech. Rept. PSW-32. Pacific Southwest Forest and Range Exp. Stn., For. Serv., U.S.D.A. p. 45-51.

A computerized mapping system originally developed for planning the control of the spruce budworm in Maine has been extended into a tool for planning road network development and optimizing transportation costs. A budgetary process and a mathematical linear programming routine are used interactively with the mapping and information retrieval capabilities of the system to determine the allocation and association of wood sources and markets.

17 PIELOU, E. C.
1969. An Introduction to Mathematical Ecology. John Wiley and Sons, New York. 286 p.

An effective guide for research workers, teachers, graduate students, and advanced undergraduates in ecology, applied mathematics, and mathematical biology. It covers the present state-of-the-art and provides valuable background for these ecologists attempting to formulate and solve their problems by mathematical reasoning.

18 PIKUS, I. M.
1973. Possibility of Technical Control Over Resource Surveying from Space. 24th International Astronautical Congress, Baku, U.S.S.R. 7-13 Oct.

19 PINKUS, Charles E.
1971. The Design of Multi-Product, Multi-Echelon Inventory Systems Using a Branch and Bound Algorithm. SC.D. Thesis. The George Washington University, 146 p.

A model for designing multi-product, multi-echelon inventory distribution systems is presented. Large-scale distribution systems require a hierarchy of retail stores and warehouses to satisfy the demand of their customers. Given the maximum number of installations and their possible locations, the problem is to determine which installations to include in the design of the system and which products to stock at these installations.

Demand for the products is assumed known and may be deterministic or stochastic. The objective is to find a solution to this design problems which minimizes the total (expected) discounted cost for the lifetime of the system. A branch-and-bound algorithm is used to solve this problem, the subproblems of the algorithm being tractable integer linear programs.

Applications of this model to the design of other multi-use, multi-facility systems are briefly described.

20 PINKUS, Charles E.
1974. Optimal Design of Multi-Product, Multi-Echelon Inventory Systems. Logistics Research Converence, Washington, D. C. 8-10 May.

21 POOLE, Robert W.
1971. The Use of Factor Analysis in Modeling Natural Communities of Plants and Animals. Illinois Natural History Survey, Biological Notes, No. 72, Urbana, IL.

This paper is divided into three parts. The first gives a brief review of basic ecological principals necessary for the following of two. The second describes the statistical procedures considered and the analysis of a specific example. The third considers the assumptions of the factor analytic model and compares them to the initial ecological generalities to see if the model mirrors the working of the community or if it only produces a set of mathematically correct but ecologically meaningless numbers.

22 POPE, M. F.
1973. Economically Optimal Project Scheduling with Multiple Resource Constraints. 44th National Meeting of Operations Research, Soc. of Amer., San Diego, CA, 12-14 Nov. B-168.

The compression of a resource-constrained project schedule is usually performed by either the cost-duration reduction of individual activities or by selective increases in resource limits. These are normally separate mathematical programming procedures. A sequence of algorithms has been developed to treat these two approaches to schedule reduction as part of a joint problem. The objectives are to find the schedule which provides the maximum present value when receipt payments are included or, the sequence of activity-reductions or limits increases which yields the schedule with the best present value for a contracted completion of the project.

23 POULTON, C. E., B. J. Schrumpf and E. Garcia-Moya.
1971. A Preliminary Vegetational Resource Inventory and Symbolic-Legend System for the Tucson-Wilcox-Fort Huachuca Triangle of Arizona. In Colwell, R.N., Monitoring Earth Resource from Aircraft and Spacecraft. p. 93-109.

This chapter is concerned with methods for mapping natural vegetation and with related resource information. The suggested procedures and the mapping example involve the application of cartographic principles and symbolic-legend concepts developed

in prior resource-analysis research at Oregon State University. The same principles and concepts, and many of the procedures, appropriate to resource inventory and analysis from large-scale aerial photography are applicable when space and small-scale high altitude photographs are the working materials.

24 PROMNITZ, Lawrence C.
1970. Optimum Replacement Policies for Multiple Objective Forest Inventories. Unpublished M.S. Thesis, Iowa State Univ., Ames, IA.

25 PROMNITZ, Lawrence C. and John W. Hazard.
1973. Multipurpose Surveys: A Question of Optimal Design. Journal Paper No. J-8082 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa, Project No. 1877. p. 69-85.

How to coordinate information needs and how to design the survey to meet these needs efficiently. This paper discusses sample design and the question of spacing in time and sample size.

26 PULFORD, William J.
1978. Regional Integrated Resource Inventories - A Place for Coordination. Integrated Inventories of Renewable Natural Resources Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A. Fort Collins, CO. p. 140-142.

Regional Integrated Resource Inventories can be useful to land managers if they recognize what items need coordination before they start the Physical Inventory. Without adequate coordination and preplanning, Regional Inventories have little potential for success.

27 PUTMAN, J., L. Harrington and T. B. Johnson.
1978. Comprehensive Resource Inventory and Evaluation System. Agric. Economics Research. 30(3):23-24.

The capacity to analyze the impacts of policies and programs on agricultural resources and their use is invaluable to developing countries, not only for resource policy analyses but also for a broad spectrum of economic analysis. Such capacity requires the development both of an inventory of agricultural resources and also of an appropriate analytical model.

Data deficiencies and limited local experience in model building hinder such development, however. Data are scarce and often of

undetermined validity while trained personnel and funds for the collection of data are usually in even shorter supply in these countries. Limited experience in modeling leads these countries to import the required expertise. All too often, however, they are left with an imperfectly understood "black box" and with no capability for refinement and updating.

The Agricultural Production Potential Study Group (APPS) of the Natural Resource Economics Division is currently constructing a Comprehensive Resource Inventory and Evaluation System (CRIES) for developing countries. The approach to resource modeling in developing countries has three main points:

- Generation and maintenance of a consistent and accurage agricultural sector data base for individual countries,

- Institutionalization of the formation system and analytical model in local decisionmaking processes,

- Development of an inventory and classification process which may collect and aggregate resource information from many countries in a conceptually consistent manner.

Q

01 QUINN, A. L.
1978. The Use of Ecological Information in Settlement Planning: A Case Example. In Applications of Ecological (Biophysical) Land Classification in Canada: Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78), Victoria, British Columbia. Ecological Land Classification Series #7. 335-344 p.

This paper addresses the question of the application of biophysical mapping to settlement planning in the context of recreational lot, rural residential, urban fringe and urban development. Special emphasis is placed on the need and demand for a wide range of mapping applications in light of new legislation pertaining to regional, settlement and community planning within the Province of British Columbia. Biophysical mapping prepared for the Tumbler Ridge townsite project in the northeast coal block area of the Province is used as a case example. A wide range of biophysical interpretations have been applied and utilized in selecting a townsite location and in preparing the conceptual design for a new townsite. No attempt has been made to describe in detail the wide range of interpretations inherent in any one type of classification system. The biophysical interpretations are, however, treated in general terms as to usefulness and application in a settlement planning context.

02 QUINN, Ao.
1968. Aerial Surveys and Provide Natural-Resource Inventory in Chile. Aerial Surveys and Integrated Studies, Natural Resources Res n 6, Proc. Toulouse Conf. Sept. 21-28, 1964, UNESCO, 1968 p. 345-9.

This is a report on a 3-year survey by aerial photography and photogrammetry of Chile's natural resources. Geological, geomorphological, climatological, meteorlogical, and hydrological aspects are discussed.

R

01 RADFORD, Albert E.
1977. Natural Area Classification System: A Standardization Scheme for Basic Inventory of Species, Community and Habitat Diversity. In Classification, Inventory and Analysis of Fish and Wildlife Habitat; Symposium, U.S.D.I. Fish and Wildlife Service. FWS/OBS-78/76 p. 243-280.

Any natural area classification system should include biotic assemblages (vegetation with accompanying fauna), climatic regime(s), soil system(s), geologic formation(s), hydrology, and land form(s) by physiographic province hierarchically arranged with each entry at each level circumscribed and encoded. The System proposed represents an effort to produce a basic standardization scheme for more efficient and effective inventory and storage and retrieval of information on natural areas, vegetation, floras, and rare, endangered and threatened species.

02 RAJ, D.
1956. On the Method of Overlapping Maps in Sample Surveys. Sankhya, 17:89-98.

In multipurpose surveys involving the estimation of several characters, it is usually found desirable to select the units with one set of probabilities for estimating one group of charactercharacters and with a different set of probabilities for estimating another group of characters. For example, in the National Sample Survey (NSS) of India, population is made the basis for selection for the household enquiry and area for the land utilization survey. An important problem arising in such a situation is that of designing a suitable selection procedure. The object of this paper is to present the problem mathematically and offer general solutions.

03 RAMOS, A. and P. Mantilla.
1976. Natural Landscapes in Spain: II, Ideas and Real Concern for Landscape Planning. Landscape Planning 3(12):25-34.

Natural landscape evaluation and planning in Spain are surveyed. Problems and approaches are similar to those utilized in many other countries, as are the divorce between academic or research fields and the action of official agencies or private companies. Nonetheless, the consciousness of the need for integrated planning of natural resources is gaining ground at all levels.

04 RANDALL, Joseph.
1975. An Analysis of Heuristic Lot Sizing and Sequencing Rules on the Performance of a Hierarchical Multiproduct, Multistage Production-Inventory System Utilizing Material Requirements Planning Techniques; Ph.D. Thesis, Ohio State Univ. 347 pages.

This thesis has as its main concern a multiproduct multistage production inventory system using material requirements planning. For such a system there exists a variety of "rules" for lot sizing, sequencing, and scheduling of the goods produced by the system. It is the purpose of this study to examine the effects of various lot sizing rules and sequencing rules on the performance of such a system using a computer simulation model.

The conclusions of this study are that combinations of lot sizing and sequencing rules perform better than either chosen singly, and that these combinations of rules must be chosen to maximize only two to three performance criteria.

05 RASHID, A.
1977. Methods and Preliminary Estimates from Saudi Arabian Multipurpose Survey. 41st Session of the International Statistical Inst., New Delhi, India, Dec. p. 5-15.

06 RASMUSSEN, William O. and Peter F. Ffolliott.
1978. Error Processing Systems for Integrated Resource Data. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 328-331.

A system of computer programs has been assembled to allow production of land suitability maps, i.e., graphical displays of numerical ratings of land for alternative management activities. One aspect of this system concerns the checking for any inconsistencies in spatially distributed data fields. Several graphic display modes for analyzing these inconsistencies are presented.

07 RASMUSSEN, William O. and Peter F. Ffolliott.
1978. Should an Organization Use Existing Data or Collect New? In Proceedings of a Workshop on Implementing Computer Systems in the Field. Soc. of Amer. For., Washington, D. C. p. 128-138.

The decision of whether to use existing data or to collect new is often not a straightforward matter, particularly when the data are only partially useable. Data may exist to a limited degree, although the coverage might not be adequate for specific simulation activities. In this case, one means of developing a useful data set is by addressing a series of questions pertaining to the characteristics of the existing, the needed, and other related data. A series of decisions and related logic flow paths have been presented to allow land management organization a possible course of action depending on his local conditions and situation.

08 RATLIFF, Raymond D. and Stanley E. Westfall.
1973. "A Simple Stereophotographic Technique for Analyzing Small Plots" Jour. Range Management 26(2):147-148.

An inexpensive stereo adapter for a camera provided stereo pairs on a single color print. At a camera height of 48 inches, obtained a good resolution of a square foot area and a scale of 1:7. The stereo prints are used with a dot grid overlay and a pocket stereoscope to estimate foliar cover and composition.

09 REAGAN, Richard N.
1976. The Forest Resource Data Base: Foundation for Managing Toward Resource Potential. Proceedings: Resource Data Management Symposium. SAF, August, Purdue University, West Lafayette, Indiana, 12-23 p.

The resource data base consists of two primary, linked cornerstones, forest inventory and forest research, capped with a third block, forest resource projections. The forest inventory as a cornerstone describes two basic attributes of the resource on a location specific basis, the land and the current status of the forest resource. The distinction is important. The land is the basic

resource. The soil/site character translates to productive capacity and, in the long run, tends to establish an upper limit on timber growth. Forest research, as a cornerstone, provides fundamental information on growth and yields for both naturally occurring stands and stands more directly created by man. And for both types of stands, information is maintained regarding the yield impact of various intensive forest management practices. The two cornerstones are linked in maintaining information on soil/site relationships and growth.

10 REEVES, R. G., ed.
1975. Manual of Remote Sensing, 2 Vols. 2144 p. Am. Soc. Photogramm., Falls Church, VA.

Covers history of remote sensing, electromagnetic radiation, interaction mechanisms, photographic systems, non-photographic systems, platforms, communication systems, data systems, ground investigations, fundamentals of image interpretation, cartographic presentations, terrain and mineral assessment, forest lands, range resources, water resources, marine environment, weather and climate, crops and soils, urban environment, engineering, regional analysis and archeology.

11 REINING, Priscilla.
1973. Utilization of ERTS-1 Imagery in Cultivation and Settlement Site Identification and Carrying Capacity Estimates in Upper Volta and Niger: Washington, D.C., Am. Univ., 172 p.

12 RENSI, Giuseppe, and H. Dean Claxton.
1972. A data collection and processing procedure for evaluating a research program. U.S.D.A. For. Serv. Res. Pap. PSW-81, 18 pp.

A set of computer programs compiled for the information processing requirements of a model for evaluating research proposals are described. The programs serve to assemble and store information, periodically update it, and convert it to a form usable for decision-making. Guides for collecting and coding data are explained. The data-processing options available and instructions on operation of the software are outlined.

13 REYNOLDS, Marion A., et al.
1978. Allocating Inventory Resources for Multiple-Use Planning. Canadian Jour. of Forest Res. 8(1):100-110.

In the past, the basic approach to gathering data for multiple-use planning has been to collect large amounts of information from all possible sources. The process has several shortcomings. First, the information gathered may not be appropriate for the planning decision. Second, the cost of data collection may be greater than necessary because not all of the information is used.

Inventories with well defined objectives are necessary because inventory costs are rising and more complex decisions must be made. There are two approaches to developing a resource-planning inventory system. The first starts with the decision maker and develops an inventory system that is user oriented. The sequence of steps for developing a user-oriented inventory system is from decision maker, to management questions, to raw data requirements, to data collection. This approach eliminates the cost of gathering data that are of no interest.

The second approach begins with the inventory design and progresses towards the decision maker. This approach does not necessarily provide the manager with the best information for decision making because inventory specialists largely determine the types of questions which can be analyzed and it is common to produce unused data.

14 RICHARD, Yvon.
1971. Stratified Random Sampling with Conditional Allocation of Observation. Quebec Department of Lands and Forests. Res. Pap. No. 3, 19 p.

The objective of several forest inventories is not only the estimation of volume, but also the collection of information for the preparation of management plans. To reach these objectives, the Quebec Department of Lands and Forests applies a stratification based on some stand variables and a distribution of sample plots among strata restricted by two conditions.

The first condition consists of the specification of a level of precision for the overall average volume. The second condition consists of the specification of a sample size for each stratum. For other strata, the required sample size is a number fixed more or less arbitrarily.

The primary objective of this work is to present a method to estimate total sample size and its distribution among strata when the two conditions are used.

15 RIPLEY, Thomas H. and David O. Yandle.
1969. A System Analysis-Ecological Control Approach to Multi-resource Forest Management. Jour. of Forestry, 67(11):806-809.

This paper outlines an approach for considering multiproduct and service alternatives in managing a forest property. It brings together some emerging pieces of knowledge, presents some concepts in a different light, and applies terminology and definitions in a different manner. It extends, we believe, important work by others.

16 ROBINETTE, Alan, Jerry W. Fuhriman, and Edward S. Crozier.
1974. A Resource Inventory System for Planning Wildlife Areas. Wildlife Soc. Bull. 2(4):178.

The resource inventory described utilizes a series of transparent overlay maps, delineating resource elements of a wildlife management area. Superimposing combinations of these maps facilitates a variety of resource-use management analyses, including, identification of planning constraints and opportunities.

17 ROHDE, Wayne G.
1978. Potential Applications of Satellite Imagery in Some Types of Natural Resource Inventories. Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A. Fort Collins, CO p. 304-306.

Landsat satellite imagery has been routinely available to researchers and resource scientists since 1972. Many studies have demonstrated the application of Landsat imagery for conducting inventories and mapping various natural resources. Examples of applications presented in this paper include: timber volume inventory, range productivity inventory, wildland vegetation mapping, inventory of rangeland conversion and irrigated lands, and mapping strip mine disturbance in forested areas. Costs and accuracies for each of these application areas are presented. Landsat data, used in its proper context with appropriate analysis techniques, supporting data, and sound sampling strategies, can be an effective tool in conducting natural resource inventories.

Other Landsat systems, scheduled for launch in 1978 and 1981, will provide continuity in the availability of Landsat data to users. Improvements in the quality and timeliness of data delivered to users, along with improved data handling procedures,

analysis techniques, and improved sampling frameworks should increase the use of satellite imagery in natureal resource inventories.

18 ROMAINE, M. J. and G. R. Ironside, ed.
1974. Canada Northlands: Proceedings of Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands. April, Toronto, Ontario, Ecological Land Classification Series No. 0. 124 p.

About 70 people attended this Workshop. They represented federal departments, most of the provinces, and two universities. The Workshop aimed to develop an integrated approach to base data surveys for 'Canada's Northlands' (the area of roughly 7,200,000 km^2 located north of the Canada Land Inventory boundary).

19 ROMERO, Adolfo C.
1976. Development of Techniques to Simplify the Process of Investigation and Estimate of Natural Resources in Remote and Relatively Unexplored Areas, Venezuela: Caracas, Dirección de Cartografía Nacional, Final Rept., NASA, 153 p.

20 ROSE, Gerald A.
1978. A Comprehensive Inventory System for Forest Resource Management. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn. For. Serv., U.S.D.A., Fort Collins, CO. p. 463-468.

The Michigan DNR has begun development of a multiple resource inventory system. Economic limitations have required development of flexible, segmented inventory systems which can eventually be combined. This system, built around a basic land unit inventory, also facilitates impact and trade-off analysis of multiple outputs under varying management strategies.

21 ROSS, J. H.
1974. PLUS (Planning Land Use System) In Canada's Northlands: Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands. (April 74) Ecological Land Classification Series No. 0. p. 83-88.

Despite certain methodological difficulties, computerized land use planning systems have a great potential, and existing systems can manipulate and display large amounts of data very efficiently. Their chief disadvantages are the cost of data input, the rigidity of decision-making mechanisms built into the systems, and their general incomprehensibility to the non-computer-expert land use planner. The Lands Directorate, in consultation with Parks Canada, has devised and preliminarily tested a computerized land use planning system designed to overcome these difficulties while retaining speed and consistency. This paper aims to describe the Planning Land Use System (PLUS) and to discuss its progress to-date. PLUS is not completely tested, however, and we are presently not in a position to assess its full potential. Ways of improving or extending it will be suggested.

22 ROW, Clark, and Bill Schmelling.
1971. Resource Information and Planning Systems: A Catalog of Computerized Systems in the U.S. Forest Service. U.S.D.A. Forest Service, Washington, D. C. 114 p.

This catalog of major resource-related computerized systems was originally prepared to help the Washington Office Advisory Staff in their study of needs for coordination of resource information systems. It soon became obvious that it made little sense to study resource information systems without considering the planning functions and types of decisions for which resource information is needed. Thus the inquiry was broadened to include five types of systems:

1. Resource information, collection and analysis systems.

2. Information storage, retrieval and display systems.

3. Resource response simulation systems.

4. Resource facility design and operation planning systems.

5. Multiple-use and environmental planning and decision systems.

Each type of system is discussed briefly at the beginning of the catalog sections.

23 ROWE, J. W.
1961. The Level-of-Integration Concept and Ecology. Ecology 42:420-427.

This article attempts to show how the idea may further illuminate both subject matter and point of view associated with ecology. It is also a commentary on the relationships between plant geography and ecology.

24 ROWE, J. S.
1962. Soil, Site and Land Classification. For. Chron. 38:420-432.

Forest management is a kind of land management, and the forester's attention is increasingly drawn to the physical land base from which forestry values derive.

Various approaches to the inventory of forest land are discussed: through soil classification with its inherited agronomic background, through site classification whose yardstick is productivity, through classification using few or many environmental factors, and through classification based on morphological features of the land itself.

Purpose is implicit in all classifications and different purposes lead to different classifications. It is suggested that forestry purposes are best served by a land classification which initially breaks the landscape pattern into geomorphological parts, each relatively constant as to surface materials. These can be further divided into relatively homogeneous forest-land patches or ecosystem units, the basis for study and prediction of productivity. As a means of reducing complexity, land inventory needs to be placed within a geographic framework of regions or zones.

25 ROWE, J. S.
1974. Surveying for Environmental Management. In Canada's Northlands: Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands. (April 74) Ecological Land Classification Series, No. 0. p. 47-52.

What is this 'environment' that is to be managed? It is the geographic space at the earth's surface, the land-and-water "landscape units" or 'terrain units' that make up the biosphere. As one organism among many, man lives in the landscape -- dependent on it and using it, hopefully without destroying its life-supporting properties. The landscape environment is an adjusted system whose parts are complexly interrelated. Environmental managers aim to safeguard the parts and relationships that are critical to the continued functioning and renewal of the biosphere.

26 RUBEC, C. D. A.
1978. Applications of Ecological Land Classification: A User Survey. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia Ecological Land Classification Series #7. 135-138 p.

A brief questionnaire, distributed to potential and current users of ecological land classification, has provided an overview of application problems and benefits associated with ecological survey in Canada. Responses were received from a wide variety of federal, provincial and corporate agencies. The need for extensive user training at all levels and the need for indepth analysis of benefit/costs of these projects are emphasized.

27 RUBEC. C. D. A., editor.
1978. Applications of Ecological (Biophysical) Land Classification in Canada. In Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification (April) Victoria, British Columbia. Ecological Land Classification Series #7. 396 p.

These proceedings report on the second meeting of the Canada Committee on Ecological Land Classification, held at Victoria, British Columbia April 4-7, 1978. This meeting focused on the applications of ecological land survey information in Canada.

'Applications' is a comprehensive term referring not only to the actual use of an ecological approach to land survey but, more so, to the interpretation of field data in such disciplines as forestry, hydrology and wildlife. The practical evaluation of ecological information for land planning and management occurs in a wide variety of locations in Canada whether it be for remote wilderness studies or urban development. The papers presented here provide a comprehensive view of the current ecological approach to land survey and information application in this country.

28 RUNKA, G. G.
1974. Physical Resource Data Needs in Land Use Planning. In Canada's Northlands; Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands (April 74) Ecological Land Classification Series No. 0. p. 37-40.

If we are to effectively plan for use of our northland, we must do so within the ecological constraints that present themselves, and to do this we must have physial resource data. Nature is a process; it interacts, it responds to laws that represent values and opportunities for human use, and it has certain limitations and even prohibitions to certain of these uses. The requirements and necessity for physical base data as a tool for any sort of resource planning are not very obvious to the public or their representatives, the politicians. The planning has gone on and will continue to go on without physical resource data; poor decisions are the result. The Peace River Dam project in North-East British Columbia is one example. Because of the lack of physical resource data, we did not foresee the very negative lesson nature has repeatedly tried to teach us: we must look beyond specific projects or resource development to the effects upon the land as an ecological whole. This is not always easy to do, and there are some very real problems to contend with.

29 RUSSELL, John W.
1976 Geographic Information Systems in Resource Planning: Proceedings Resource Data Management Symposium, SAF, August, Purdue University, West Lafayette, Indiana. 70-78 p.

This commentary is intended to give one definition of what planning and the planning process is, and identify where geographic information systems fit into that process. Some observations are given on the types of geographic information systems in general and also the state-of-the-art in relation to some general data requirements.

30 RUSSELL, Peter R.
1978. Information Requirements for Timber Management: Just Part of an Integrated Information System. Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A. Fort Collins, CO. p. 42-44.

Information requirements for timber management overlap with the requirements for log and tree allocation, log, tree and stand valuation, facility planning and measuring plant performance. Resource data can be integrated with log input/product output relationships, market data, production and transportation costs to provide a "vertically" integrated data base for decision making.

31 RUSSELL, Robert M., David A. Sharpnack, and Elliot L. Amidon. 1975. Wildland Resource Information System: User's Guide. U.S.D.A. For. Serv. Gen. Tech. Rep. PSW-10, 36 pp.

This user's guide provides detailed information about how to use the computer programs of WRIS, a computer system for storing and manipulating data about land areas. Instructions explain how to prepare maps, digitize by automatic scanners or by hand, produce polygon maps, and combine map layers. Support programs plot maps, store them on tapes, produce summaries, and perform housekeeping tasks.

32 RUSSELL, Robert M., David A. Sharpnack, and Elliott L. Amidon. 1975. WRIS: A Resource Information System for Wildland Management U.S.D.A. For. Serv. Res. Pap. PSW-107, 12 pp.

WRIS (Wildland Resource Information System) is a computer system for processing, storing, retrieving, updating, and displaying geographic data. The polygon, representing a land area boundary, forms the building block of WRIS. Polygons form a map. Maps are digitized manually or by automatic scanning. Computer programs can extract and product polygon maps and can overlay, plot, and store them, as well as aggregate acreages and print summaries. WRIS is functionally oriented toward timber management, but can be used for other types of resource activities.

S

01 SADOWSKI, F. G., W. A. Malila and R. F. Nalepka. 1978. Application of MSS Systems to Natural Resource Inventories. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 248-256.

A recent investigation has shown that several factors can have important implications for the use of multispectral scanner (MSS) data in support of forest resource inventories. The results show that the accuracy for classifying forest features is greatly dependent on the spatial resolution of the data, the level of detail desired, and the processing technique employed.

02 SANDVIK, L. 1978. Note on Direct Multiple Sample Consensus. Biometrics 34(3):523.

An error has been detected in the proof of a theorem concerning approximate methods for calculating a population estimate, presented by D. G. Chapman in "Inverse, multiple and sequential sample census," Biometrics 8, 286-306, 1952. This note corrects that error.

03 SAPLACO, Severo R.
1978. Multi Resource Inventory in the Philippines. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 430-433.

General and specific methodologies of gathering and evaluating information designed to provide data-base for multi-forest resource management in the Philippines are discussed. Emphasis was made at the district level.

04 SAYN-WITTGENSTEIN, L.
1977. Remote Sensing and Today's Forestry Issues. Presented at the Proceedings of the 11th International Symposium on Remote Sensing of Environment, April 1977. Reprinted by Forest Management Institute, Canada Forestry Service, Dept. of Fisheries and the Environment, Ottawa, Canada.

The purpose of this paper is to examine the actual and the desirable roles of remote sensing in dealing with current forestry issues, such as national forest policy, supply and demand for forest products and competing demands for forest land.

05 SAXTON, Gerald Fay.
1972. An Approach for Evaluating Interactions in a Multi-Product Total Cost Inventory Model. Ph.D. Thesis, Arizona State University. 254 p.

The most important contribution of this study was the development of an analytic procedure to account for the product interactions that occur in the space and bin cost factors of the model. The

procedure provides for the allocation of the multi-product stock level into individual product components so that individual optimum order quantities could be calculated.

As a result of this study, the following conclusions have been reached by the author:

1. The continuous, deterministic approximation of the true discrete inventory system was not good enough to be able to show that the distribution of total stock level obeyed a normal probability law as was predicted through the use of the central limit theorem. However, the observed results conformed close enough to normal parameters that the assumption of normality proved to be a reasonable representation of the true case.

2. For the types of workload examined in the example problems, the assumption that area and bin costs were proportional to actual maximum stock level, was a valid approximation.

3. The analytic and simulated models both yielded approximately the same results. Where significant differences existed, they were small in magnitude, and were the result of inherent differences in a continuous and discrete approach to the inventory problem.

4. The deterministic model is probably a reasonable approximation to the true stochastic case.

06 SCHMID-HAAS, Paul (Editor).
1976. Inventories on Successive Occasions. Working Group S-4.02.3. International Union of Forest Research Organizations. Papers Presented at the XVIth IUFRO World Congress in Oslo, June 20-July 2, 1976.

Includes papers presented at the above meeting. Topics are: Sampling Designs for Continuity in Forest Inventory, Tree-Sampling, Forest Inventory Data and Construction of Growth Models, Stand Projection, Mean Annual Volume Growth from Sequential Volume Determination on Permanent Aerial Photographic Plots, Monitoring, Forest Environment with Photo Densitometer through Successive Sampling, The Northern Ireland State Forest Inventory and Production Forecast, Accuracy in Pre-Sale Timber Inventory.

07 SCHRUMPF, B. J., et al.
1975. The Comparative Evaluation of ERTS-1 Imagery for Resource Inventory in Land Use Planning. Gov. Rep. Ann. E-75-1041321P.

08 SCHUMACHER, F. X., and R. A. Chapman.
1954. Sampling Methods in Forestry and Range Management. Duke University, School of Forestry, Bulletin 7, Revised. Durham, North Carolina. 221 p.

Textbook on introductory sampling methods.

09 SCHWARZ, Charles F., Edward C. Thor, and Gary H. Elsner.
1976. Wildland Planning Glossary. U.S.D.A. For. Serv. Gen. Tech. Rept. PSW-13, 252 p. Pacific Southwest Forest and Range Exp. Stn., Berkeley, CA.

More than 1400 terms useful in wildland and related resource planning are defined. The purpose of the work is to facilitate communication between professionals, not to provide them with exhaustive vocabularies of each other's specialties. Definitions are drawn from many sources, including public laws and government manuals, but are not intended to establish legally binding definitions. A list of terms and list of sources are included.

10 SCHWARZBART, Gideon.
1976. Overview of Generalized Data Base Management Systems. Proceedings, Resource Data Management Symposium. SAF, August, Purdue University, West Lafayette, Indiana; 34-38 p.

Generalized data base management systems represent a novel technology for the storing and retrieving of operational data. Among the benefits are a degree of data independence, sharing of data resources within the organization and fast access to data by users. The limitations include the need for additional administrative and procedural controls to maintain data base integrity and data base security and added requirements for direct access storage and telecommunications facilities.

11 SCHWARZBART, Gideon, E. Hirsch, T. Lennon, J. R. Robertson, E. Rockey.
1975. Benchmark Tests on Mapping Systems Used by the U.S. For. Serv., In Systems Analysis and Forest Resource Management. Proceeding Workshop by SAF, University of Georgia, Athens, p. 394-409.

The benchmark tests seek to establish the operational characteristics of U.S. Forest Service grid and line mapping systems to compare computerized mapping systems to manual operations. The characteristics examined are: input requirements, processing capabilities and special options, output appearance, accuracy

and reliability, manpower needs, organizational support requirements, throughout times, cost and manpower break-even levels, and suitability for various applications. Findings indicate that the cost break-even points are high (i.e. more repetitive uses of field base map data than anticipated are necessary before dollar savings are realized) for all computerized mapping systems examined especially for line mapping systems. This is due principally to the high preparatory costs before clean map data can be stored. The line mapping systems examined were: GELO, WRIS, and PLOT; the grid mapping systems were: LIM(R2MAP), R3MAP, GRID and MIADS2.

12 SCOTT, Robert B. and Roger A. Harding.
1975. Satellite and Airplane Remote Sensing of Natural Resource in the State of Washington. Proc. of the Int. Symp. on Remote Sensing of Environ., 10th Ann Arbor, Mich. 2:893-900.

The State's Department of Natural Resources (DNR) has multi-disciplinary statewide governmental and proprietary responsibilities. The DNR obtains and indexes state-wide aerial photography (black and white, color and FCIR) which is used for many purposes including inventory. Under contract, the DNR has developed potential applications for Landsat data, and is a key participant in the joint USDI-EROS, NASA-AMES and Pacific Northwest Regional Commission Land Resource Inventory Demonstration Project.

13 SEGEBADEN, G., Ragnar Stromnes, and Herbert I. Winer.
1967. Proposal for International System of Terrain Classification. The Working Group on Terrain Classification, IUFRO, 14th Congr., Munich, Sect. 31-32, VIII:756-764.

The system described the most important terrain factors which effect forest management. Terrain factors which can be described objectively are used as much as possible. The system does not specify on how detailed or what is the minimum to be recognized.

14 SHAW, J. H.
1974. The Rationale for a Land Resource Inventory. Agric. Technol. 5(1):4-6.

15 SHELTON, Ronald L. and Ernest E. Hardy.
1971. Cornell Environmental Inventory and Planning Techniques. Univ. of Ill. at Urbana-Champaign, Urbana, IL 61801. 13 p. Pap. Presented at 37th Ann. Mtg. Amer. Soc. Photogrammetry.

Cornell techniques for conducting environmental inventories, and experience in assisting others to establish similar techniques, are summarized under eight general headings: design, classification, data acquisition, geographical referencing, data processing, data storage, data retrieval, and applications. Both inventory and data system aspects of environmental planning are discussed, with techniques referenced to those used in the New York State Land Use and Natural Resources Inventory and for a similar project of the Hudson River Valley Commission.

16 SHELTON, Ronald L. and Ernest E. Hardy.
1974. Design Concepts for Land Use and Natural Resource Inventories and Information Systems. 9th International Symposium on Remote Sensing of Environment. 15-19 Apr. (1):517-535, Ann Arbor, MI.

The design, implementation, application and maintenance of inventories and information systems for land use and natural resource data are discussed in terms of the remote sensing and computer technology which has in recent years become an important feature of information system development. Basic concepts in use of that technology are outlined from the perspective of potential users of systems and data. Seventeen steps are suggested as guides in the design of systems and projects.

17 SHOSHANI, Arie.
1969. Detection, Prevention and Recovery from Deadlocks in Multiprocess Multiple Resource Systems. Ph.D. Thesis, Princeton University, 124 p.

Whenever a collection of resources has to be shared among more than one user, a logical problem called the "deadlock" problem arises. Deadlock is a situation in which two or more jobs can never be completed because of conflicting resource requirements. Any computer system permitting more than one process (job) to run concurrently (by means of multiprogramming and/or multiprocessing) may be subject to this problem.

One approach to the deadlock problem, which is discussed in Chapter 2, assumes no advance information about future resource requirements by jobs. Methods for detection, prevention and recovery of deadlocks are discussed. A second approach which is discussed in Chapter 3 assumes the availability of certain advance information. Jobs are assumed to be represented as sequences of job steps during which resource usage remains constant. This provides a basis for comparing models which use

different amount of advance information as to their resource utilization. An Algorithm which determines whether a request can be granted without causing a deadlock is developed. Chapter 4 discusses the problem of synchronizing routines which access a data base in parallel. An Algorithm for synchronizing the routines in such a way that deadlocks are avoided is given, and shown to be optimal with respect to parallel activity in the data base. Chapter 5 summarizes the results and points out possible future work.

18 SIMONSON, G. H., et al.
1973. Natural Resource Inventory and Monitoring in Oregon with ERTS (Earth Resources Technology Satellite) Land Use Planning. In Symposium on Significant Results Obtained from the Earth Resources Technology Satellite 1, Proceedings 1, Sec. B:1451-1457.

Multidiscipline team interpretation of ERTS satellite and high-flight imagery is providing resource and land use information needed for land use planning in Oregon. A coordinated inventory of geology, soil-landscapes, forest and range vegetation, and land use for Cook County, illustrates the value of this approach for broad area and state planning. Other applications include mapping fault zones, inventory of forest clearcut areas, location of forest insect damage, and monitoring irrigation development. Computer classification is being developed for use in conjunction with visual interpretation.

19 SIMONSON, G. H., et al.
1973. Symposium on Significant Results Obtained from the Earth Resources Technology Satellite 1, 3 Volumes. New Carrollton, MD, Mar 5-9, 1973, Vol. 1 (NASA Spec. Pub. SP-327), Vol. 2 (X-650-73-127), and Vol. 3 (X-650-73-155).

Following is a continuation of the list of titles and authors: Natural Resource Inventory and Monitoring in Oregon with ERTS Imagery. By G. H. Simonson, D. P. Paine, C. E. Poulton, R. D. Lawrence, J. H. Herzog and R. J. Murray. Resource Management Implications of ERTS-1 Data to Ohio. By David C. Sweet, Terry L. Wells and George E. Wukelic. Assessment of Southern California Environment from ERTS-1. By Leonard W. Bowden and James H. Viellenave. Applications of Remote Sensing (ERTS) to Resource Management and Development in Sahelien Africa (Republic of Mali). By N. H. MacLeod. First ERTS-1 Results in Southeastern France: Geology, Sedimentology, Pollution at Sea, by A. Fontanel, J. Guillemot and M. Guy.

20 SIMPSON, R. B.
1965. Radar as a Tool for Surveys of Underdeveloped areas, In Ann. Mtg., Assn. Am. Geog., 61st, Columbus, OH, 1965: Annals, Assn. Amer. Geog., 555(4):646.

The first opportunity to examine sidelooking airborne radar (SLAR) imagery on an unclassified basis has been provided by the declassification of the earliest standard U.S. set, the AN/APQ-56 imagery are shown, revealing a definite capacity for recognition and delineation of natural and cultural landscapes.

A radar survey is shown to cost some 75 percent less than a conventional mapping program due to the ability to record through cloud cover and at night, as well as to cover a tremendous area on each flight and on each roll of film. On the other hand, image resolution is only 50 feet or better for the APQ-56, compared to 10 feet for conventional mapping photography. Areas of typical broad landscape patterns normally are measurable to within 5-10 percent. Locations of points generally are accurate to within 1,000 feet.

It is concluded that SLAR surveys are a highly effective and extremely economical means of:

1) providing up-to-date semicontrolled mosaics of large areas,

2) providing overlays showing natural regions, the major patterns of geomorphology, vegetation, soil, and land utilization, and the details of drainage basins,

3) determining areas suitable for introduction of various landscape-related items (as, irrigated agriculture),

4) carrying out geological reconnaissance and preliminary mineral resource exploration,

5) accomplishing route and site selection appropriate to the scale,

6) determining the areas which merit Class A mapping programs.

If necessary, SLAR surveys can provide interim substitutes for Class A map sheets at scales of 1:250,000 or smaller.

21 SIVAZLIAN, Boghos D.
1966. Inventory Control of a Multiproduct System with Interacting Procurement Cost. Ph.D. Thesis. Case Inst. of Tech., 214 p.

The characteristics of a multiproduct, multiwarehouse periodic review inventory system in which interdependency between commodities and/or warehouses is introduced through set-up costs, are investigated for probabilistic demand. For a two-commodity system, the one and two period problems are analyzed. By specifying the structure of the inventory policy, the statistical properties of the system can be studied and optimal decision rules arrived at. For the stationary problem, the fundamental equation dealt with is similar to the basic renewal equation, though one is dealing rather with vector random variables. Concepts in mapping, differential and variational calculus are used in working out the optimization problem for the case when demands are independently and exponentially distributed. The results of the two-commodity problem are then extended to an m-commodity (m-warehouse) (m=1,2,...) problem.

22 SLEE, Louis F., and Perkinson, Jesse Dean.
1976. Via Satellite. Americas, 28(1):19-30 (also in Spanish, Portuguese).

QUIEN SIENTE AMOR por el mundo en que vive, la tierra que de vio nacer y el suelo que le proporciona los alimentos, los quiere lo más fructiferos posible, pro su propio bienestar, el de sus hijos y el de todos. El continuo desarrollo económico de nuestras naciones exige una mayor abundancia de frutos, de agua limpia y de minerales con que satisfacer las crecientes necesidades del progreso y aun la propia supervivencia de una población en constante aumento. Pues bien, uno de los mas eficaces instrumentos al servicio del desarrollo economico es la ciencia de la percepción remota.

Esta es el procedimiento mediante el cual results posible obtener informaciones y datos sobre la estructura física de la berra gracias a un instrumento sensorio situado a gran altura. Además de las lentes telescópicas, las cámaras cinematográficas han sido reconocidas, desde tiempo atrás, como medios sensibilisimos de percepción y hoy están desempeñnando una importante función al registrar, fotográficamente, suelos, rios y costas.

23 SMELSER, R. L., Jr. and Andrew W. Patteson.
1975. Photointerpretation Guide for Forest Resource Inventories. Lockheed Electronics Co., Inc., Houston, TX. Rept. No. LEC-4302. 250 p.

The guide explains the use of small-scale photography for inventorying and assessing resources. The manual introduces high-altitude, color infrared photography to investigators familiar with conventional photointerpretation techniques. Although other film types and scales may be better suited for specific tasks in forest resource inventories, this guide emphasizes the use of 1:60,000-scale color infrared film because of the advantages for forestry investigations. A loose-leaf binder format permits updating the guide as more techniques become available. In the guide, a brief review of aerial photography and photointerpretation precedes sections on evaluation and applications. The review sections cover the resource requirements, photographic preparation, and mensuration techniques needed to apply the methodology described in the applications. The statistical evaluation of aerial mapping is covered to provide the user with a methodology for evaluating accuracy, establishing confidence limits, and determining the required sample size. Applications covered in the guide include land use classification and mapping, landform analysis, timber stand mapping and erosion detection.

24 SMITH, Charles H., et al.
1974. Land Resources. U.S.G.S. Earth Science in the Public Service Sym. VA, July 10-13, 1974. 2-44.

Geological Surveys, environmental analysis, and earth sciences in the public service are discussed, and a resource and environmental data analysis is presented. New directions in topographical mapping, geodynamics, earth resource surveys, federal interagency coordination of natural resource studies, land resource use and analysis, technology information transfer, an interdisciplinary approach to the solution of natural resource problems, and natural hazards reduction are examined.

25 SMITH, Edwin L., Phil R. Ogden and Ernest B. Fish.
1975. Use of Earth Resources Technological Satellite (ERTS) Data in a Natural Resource Inventory. Univ. of Arizona, School of Renewable Natural Resources, Tucson, AZ. 101 p.

26 SMITH, Victor G.
1976. Canadian Forest Inventory Methods. The Forestry Chronicle, Feb. Univ. of Toronto, Toronto, Canada.

The various provincial forest inventory methods are compared on the basis of base maps, photo interpretation, ground plots, stand volume tables, growth estimation and reinventory. Comments are made suggesting areas in which problems exist and where improvements in the various methods can be made.

27 SNEDECOR, George W. and William G. Cochran.
1974. Statistical Methods, 6th Ed., Iowa State Univ. Press, Ames, Iowa. 593 p.

Textbook on introductory statistics and a reference for research workers in the interpretation of their data.

28 SOCIETY OF AMERICAN FORESTERS.
1977. Aerial Color Photography in the Plant Sciences and Related Fields. Proceedings of the 6th Biennial Workshop on Aerial Color Photography in the Plant Sciences. 153 p.

Includes the texts of papers presented at the 1977 workshop. They include some new and some modifications of existing techniques on how color aerial photographs can help resource managers do their jobs more efficiently.

29 SOKOL, R. R.
1974. Classification--Purpose, Principles, Progress, Prospects. Science, 185 (4157): 1115-1123.

Toxonomy is the science of classification. This article will mainly concern itself with the second aspect of classification: (How should we classify) the principles and procedures.

30 SPACE, James C.
1975. Data Processing System for Small Ownerships. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept.
RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 336-343.

The development of generalized data processing systems for forest inventories, first applied to the job of processing large volumes of data, has been extended to inventories of small ownerships in recent years. For many users, the advantages of such systems may lead to significant cost and time savings over custom-written

programs. Although no one system includes all desirable features, improvements are constantly being made. The next logical step, already being tried on a limited basis, is to apply these techniques to integrated inventories.

31 SPACE, James C., William E. Balmer, and H. Gyde Lund.
1976. Computer Programs for Forest Management Planning on Small Ownership. U.S. For. Serv., State and Private Forestry, Wash., D. C. 34 p.

The study identified and evaluated computer programs which could be used by Service and Consulting Foresters in the development of management plans for tracts less than 1,000 acres in size. Included are programs for stand accounting, cruising and inventory, resource allocation modeling, and financial analysis. Only non-proprietary programs were considered.

To be considered, a program had to be sufficiently general in nature that extensive reprogramming was not necessary, have instructions clear enough to be used by the typical Service Forester or consultant, and well documented so that making necessary changes would not be an insurmountable problem. The facilities and procedures necessary for use of the program by field personnel were also a major consideration.

32 SPEIGHT, J. Garry.
1977. Landform Pattern Description from Aerial Photographs: Photogrammetria, 32(5):161-182.

A system is proposed to facilitate the delineation and description of regions of homogeneous landform pattern as perceived in aerial photographs. From resource survey experience in Papua New Guinea, a comprehensive suite of some sixty landform attributes is erected on the concept that a landform pattern may be described by altitude, relationship of planes of accordance, development of networks and lineations, proportional occurrence of landform elements and the organization of these landform elements in toposequences. It is argued that flexible landform classifications based on explicit attributes should replace classifications in which landforms are allocated to preconceived categories (pigeonholes) if landform classification is to contribute to the study of the genesis of landforms and their relationships to other phenomena.

33 STAGE, Albert R.
1971. Sampling with Probability Proportional to Size from a Sorted List. U.S.D.A. For. Serv. Res. Pap. INT-88, 16 pp.

Describes a sampling technique and related computer program for drawing a sample with probability proportional to size from a list of the population elements and their corresponding sizes. The sampling process is systematic, without replacement.

34 STAGE, Albert R.
1974. Playing with Probabilities: One Key to Meeting Information Objectives. In Inventory Design and Analysis. Sponsored by the Inventory Working Group. Proc. Workshop Soc., SAF, Colorado State University, Fort Collins, CO, July 1974, p. 18-37.

Outlines how sampling probabilities which are the basis for inferring population totals from sample data, can be arbitrarily modified to meet manager's diverse needs for information. Several well known sampling designs are shown to be special cases of this generalized estimation procedure. Arbitrary assignment of probabilities is illustrated for a combined inventory of timber volumes and pest losses.

35 STAGE, Albert R. and Jack R. Alley.
1972. An Inventory Design Using Stand Examinations for Planning and Programing Timber Management, U.S.D.A. For. Serv. Res. Pap. INT-126, 17 pp.

Considerations guiding the design of a forest inventory for providing "in place" data for planning and programing timber management are discussed. A design is described for an inventory intended to be transitory between previous inventories that provided estimates only of forest totals and later inventories that could use a complete forest record of "in place" data.

36 STATES, James B.
1978. A Practical Approach to Biological Inventories for Ecological Baseline Studies. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55,
Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 447-454.

A number of historical and functional reasons are given for the difficulty encountered by environmental scientists and resource managers in coping with the demands of NEPA. A recent convergence of professional thinking toward resolving these difficulties is outlined in the form of a step by step approach to designing ecological baseline studies for maximum impact upon energy development decisions.

37 STEINITZ, Carl, Paul Parker and Laurie Johnson.
1976. Hand-Drawn Overlays - Their History and Prospective Uses. Landscape Architecture Sept. 444-455.

First, we describe the historical development of hand-drawn map overlay techniques; next, we propose a variation on the previous methods so as to gain the analytic efficiency of a computer-like approach to data files and an increased graphic flexibility.

38 STOUT, Glenn E.
1978. Baseline Data Requirements for Assessing Environmental Impact, Illinois Univ. at Urbana-Champaign. 140 p.

This study has developed a guide that may be used by technical personnel to perform an integrated baseline evaluation of changes in the total environment--in plants, soils, and animals (including man--that is needed for a factual point assessment.

The methodology outlined in this guide requires substantial resources both in manpower and funds. The management and evaluation of the survey instrument should be performed by a qualified organization. Comprehensive ecosystem evaluation requires an interdisciplinary team of scientists. As a result, the execution of a baseline impact assessment requires considerable planning, funding, and evaluation.

39 STUCK, Roger Dean II.
1976. Increasing the Efficiency of Multiple-Use Inventory Procedures. Virginia Polytechnic Institute and State University. Ph.D. Dissertation. 134 p.

Two approaches were used to evaluate multiple-use inventories. The first approach was to analyze inventory data currently being collected. Assuming that all variables being inventoried are necessary in making decisions for multiple-use management, simple correlation, multiple linear regression, and factor analysis techniques were employed. Data from the Jefferson National Forest in Virginia were analyzed but no strong association between variables currently being observed was detected.

The second approach was to define the decisions that are to be made and the variables necessary to make these decisions. Once the variables have been defined, sampling intensity must be determined. The decision-maker was not required to define the sampling intensity based on experience or a rule-of-thumb, but rather a cost-loss function for multiple inventories and

multiple decisions was minimized. The cost of collecting data will increase as sample size increases, while the expected monetary loss that will occur to the decision-maker from making decisions with inventory data will decrease. Minimizing the cost-loss function determines the sampling intensity that will provide the lowest total (cost plus loss) monetary cost to the decision-maker. Methods were developed to determine necessary information for the cost-loss function, and several methods of minimization were evaluated.

40 STUCK, Roger Dean II and Harold E. Burkhart.
1978. A Framework for Allocating Inventory Resources for Multiple-Use Planning. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 307-314.

In the past, the basic approach to gathered data for multiple-use planning has been to collect large amounts of information from all possible sources. This process has several shortcomings. First, the information gathered may not be appropriate for the planning decisions under consideration. Second, the cost of data collection may be greater than necessary because not all of the information is used.

Inventories with well defined objectives are required because inventory costs are rising and more complex decisions must be made. A user-oriented approach for gathering multiple-use planning inventory data is presented. The sequence is to determine (1) the decisions to be made with the aid of inventory data, (2) the data needed to soundly base the decisions, and (3) the impact of sampling error in the data on the decisions. Sample intensities that minimize the cost of obtaining data plus the expected losses from using the data to make decisions are determined.

A cost-loss minimization framework for multiple-use planning inventory was developed and applied to a case study on a U.S. Forest Service planning unit. Results indicate that the procedure should provide useful guides for allocating sampling resources.

41 SUDMAN, S.
1976. Applied Sampling. New York: Academic Press. 249 p.

This book is intended for researchers who wish to use survey methods for data collection, but who have limited experience and resources. In far too many cases, these researchers are aware that powerful sampling methods are available, but believe

they cannot use them because these methods are too difficult or expensive. In this book, we concentrate on alternative methods which are much less expensive and only slightly inferior to the most precise methods.

42 SUPALLA, Raymond L.
1976. Land Use Planning: What, Why, When, and by Whom. Agric. Exp. Stn. Research Report 323, New Mexico State Univ. 16 p.

Land-use planning is defined in terms of eight stages: projecting land-resource needs, identifying land-use alternatives, evaluating land-use alternatives, choosing land uses, evaluating land-use control techniques, choosing control techniques, and administering land-use programs. Each stage is discussed with reference to the necessary activities, information and personnel.

43 SVENSSON, Harald.
1970. Remote Sensing. Trans. of Forskning Och Framsteg (Sweden) 5:10-19, 1969. Air Force Cambridge Research Labs, L. G. Hanscom Field, MA. AFCRL 70-0277. 24 p.

The parts of the electromagnetic spectrum are discussed with the type(s) of sensor(s) required to record energy in each part. A review is given of the classes of airborne (and satellite) remote sensor data which are available to geoscientists. Different types of remote sensor data are described and examples provided, including panchromatic, infrared, color, and color infrared aerial photography (Kullaberg, Sweden); multispectral aerial photography (with importance of optimum film/filter combination for specific phenomena); airborne thermal infrared imagery (Kullaberg, Sweden and Surtsey, Iceland); side-looking airborne radar (Tuskahoma Syncline, Oklahoma); and radio sounding of glacial ice (Antarctica). The projected future increase in amount of remote sensor data will require computer processing techniques, although man will serve the most important role in the analysis and use of remote sensor information of the earth's surface.

44 SWANSON, Roger A.
1969. Land Use and Natural Resource Inventory of New York State. New York State Office of Planning Coord., Albany, 26 p.

The land use and natural resource inventory is a program to identify and record how the state's land resources are being utilized. This comprehensive inventory, the first to be

undertaken in the state, examines and identifies from aerial photographs the use of all land area in all 62 counties. An operating land use and natural resource data system with an expanding computerized data library will include the entire state.

45 SWINNERTON, John R.
1969. Land Resource Inventory and Engineering Surveys Using Photogrammetry. U.S.D.A. For. Serv. Tech. Rept. ETR 7100-2. 14 p.

The basic objectives of the Sierra Demonstration Project are to apply new techniques and procedures to forest land resource inventory, engineering surveys and design, and automated mapping. Techniques include the use of color photography, analytical bridging and block adjustment, multi-scale control extension, and the use of the electronic computer and the electronic coordinatograph. These techniques have been used by the Forest Service and others for single purposes. The focus of the demonstration project is to integrate several techniques in order to obtain all necessary information for many purposes concurrently.

T

01 TAAFFE, Kenneth Jr.
1979. Computing Optimum Plot Size for Wildland Inventories. U.S.D.I. Bur. Land Mgmt., Resource Inventory Notes 23, p. 8-15.

The paper presents an example, using real data from a reconnaisance inventory of the Paraguayian Chaco, of how to compute the theoretical sample plot size, that will minimize field work, while meeting a given precision. This example would be of use in inventories of wildland areas, where the effect of plot size on the amount of field work is not known. The discussion demonstrates how to use the analysis in choosing the proper plot size, while considering other factors as well.

02 TARDIF, Gilbert.
1965. Some Considerations Concerning the Establishment of Optimum Plot Size in Forest Survey. For. Chron. 41:93-102.

A simple method has been studied in order to determine the optimum plot size in forest inventories. This approach, at this stage of development, even if it appears quite academical by nature, nevertheless confirms the conclusions of many authors who all agree that the size of the plots should be tailored to the type of the stand.

03 TARNOCAI, C. and G. J. Beke.
1973. Application of Remote Sensing Techniques to Resource Inventories. Can. Agric. 18(2):14-17.

The Manitoba-Agriculture Canada Soil Survey has carried out studies in the past two years to determine the potential of remote sensing carried out simultaneously in several wavelengths bands of the electromagnetic spectrum, specifically in its application to soil, vegetation and terrain. Multispectral remote sensing data in the visible, near infrared and thermal infrared were obtained by use of low- medium- and high-flying aircraft at several locations in Manitoba. The results of these studies, with examples, are very briefly discussed to illustrate the potential of this new technique.

04 THIE, J. O.
1974. Remote Sensing for Northern Surveys and Environmental Monitoring. In Canada's Northlands; Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands. (April 74) Ecological Land Classification Series. No. 0. p. 31-36.

Classification systems for mapping and describing the earth's surface evolved from single discipline oriented systems into integrated ones--from separate soil classifications, vegetation classifications, forest inventories and geomorphological systems, into ecologically based ones. In brief, an adequate survey system should:

1) be ecologically based,

2) integrate water and land classification,

3) describe present status,

4) allow for monitoring of changes (natural or man-caused),

5) map and describe units for multidisciplinary resource planning and/or management,

6) be rapid and inexpensive.

05 THIE, J. O. and G. Ironside, ed.
1976. Ecological (Biophysical) Land Classification in Canada. Proceedings: Canada Committee on Ecological (Biophysical) Land Classification. Petawawa, Ontario. 25-28 May 1976. Ecol. Land Class. Series No. 1.

At this first meeting held in Petawa, the terms of reference, organization, membership, activities and working groups were described. In addition, these proceedings give the papers that were presented discussing the present methodology and status of application of biophysical land classification in Canada.

06 THIE, T. O., N. Chartrand and G. Mills.
1978. Interpretation of an Ecological Data Base Using the Canada Land Data System. In Applications of Ecological (Biophysical) Land Classification in Canada; Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7, 351-360.

An integrated ecological land data base provides a great flexibility in intepretations to resource planners and managers. The wide variety of questions that can be asked or and answered instantaneously by such a data base is demonstrated through interactive analysis capabilities of the Canada Land Data System (CLDS). For this purpose the CLDS was adapted to store and analyse ecological data for an area of about 1800 km^2 mapped by the Manitoba Northern Resource Information Program. This paper was originally written as background material for an Interactive Graphics Display demonstration given at a CCLEC workshop in Victoria.

07 THIE, J. O., C. Tarnocai, and G. Mills.
1974. A Rapid Resource Inventory for Northern Areas by Means of Satellite and Airborne Remote Sensing. 2nd Canadian Symposium and Remote Sensing, 29 Apr-01 May. 199-216 p.

There is an urgent need in Canada for northern baseline data for resource policy and planning purposes. To evaluate the impact of airborne and satellite remote sensing for Northern Inventories three areas were studied in boreal, arctic and sub-arctic environments. ERTS satellite imagery was found to be very effective for a rapid mapping of bio-physical units and can provide an excellent basis for integration of water and land-based classifications. An operational system for a rapid, broad brush inventory is proposed for Canada, costing in the order of 2-4 dollars per square mile.

08 THOMAS, R. W. and S. D. DeGloria.
1979. Large-Scale Aerial Photography as a Sample Stage in Wildland Resource Inventories. Pap. Presented 7th Biennial Workshop on Color Aerial Photography in the Plant Sciences, Davis, California. 19 p.

The management of renewable natural resources requires accurate, timely, and efficient inventories. Sample methods which incorporate large-scale aerial photography enhance this inventory process by reducing the cost and sampling error of estimates. Many of the factors which must be evaluated when designing and conducting LSP-aided inventories are addressed. These include auxiliary variate definition, evaluation of appropriate sample systems, construction of cost and sample size ratios between large-scale aerial photography and ground measurements, and discussion of inventory efficiency. Acquisition, measurement, and error sources associated with using large-scale aerial photography as a sampling medium are discussed. Recent applications which illustrate these inventory components are cited. Problem areas and improvements needed to increase the efficient utilization of LSP are also addressed.

09 THOMASSON, R. D.
1974. Human and Physical Data Needs in Land Use Planning. In Canada's Northlands; Proceeding of a Technical Workshop - To Develop an Integrated Approach to Base Data Inventories for Canada's Northlands (April 74) Ecological Land Classification Series No. 0. p. 41-44.

Land use plans for Crown land in Manitoba are developed to allocate land to uses and to integrate uses within land areas so that the goods and services required by people for a high quality life can be provided. The data needed for plan development falls either into the human category or into the physical category. Physical data is largely static, whereas human data is dynamic.

The planning process consists of three basic steps: 1) the gathering and assessment of human data to determine demands; 2) the gathering and assessment of physical data to determine land capability for various uses; and 3) the matching of demands to the land to produce the goods and services required, to ensure maintenance of environmental quality, to facilitate efficient production of goods and services, and to minimize land use conflicts.

10 THOR, Edward C., G. H. Elsner, M. R. Travis, and K. M. O'Loughlin.
1978. Forest Environmental Impact Analysis - A New Approach. Jour. Forestry 76(11):723-725.

Impact is a new computerized approach that has been developed by the U.S. Forest Service to simplify the work of land-management agencies in conducting environmental impact analyses and in

preparing impact statements. Impact consists of an information base and an interactive computer program. The information base is a complex network of short descriptions of environmental conditions linked together in cause-and-effect relationships associated with a variety of forest management activities. The information base also includes literature references useful in analyzing specific environmental effects. Impact is being used on several national forests.

11 TITUS, Stephen J.
1975. Integrated System for Computer Processing of LANDSAT-1 Imagery, Large-Scale Photography, and Ground Data to Produce Resource Inventory Estimates Based on Stratified Multistage Sampling Techniques. Symposium on Machine Processing of Remotely Sensed Data, West Lafayette, Ind., 3-5 June. p. 44-45.

12 TITUS, Stephen J. and Lee C. Wensel.
1977. Use of Multispectral Data in Design of Forest Sample Surveys Proc. 11th Int. Sym. Remote Sensing Environ. Ann Arbor, MI. p. 505-513.

The use of multispectral data in design of forest sample surveys using a computer software package, WILLIAM, is described. The system allows evaluation of a number of alternative sampling systems and, with appropriate cost data, estimates the implementation cost for each.

13 TITUS, Stephen J., M. Gialdini, and J. Nichols.
1975. Total Timber Resource Inventory Based Upon Manual and Automated Analysis of LANDSAT-1 upon Supporting Aircraft Data Using Stratified Multistage Sampling Techniques. 10th Internat'l. Symposium on Remote Sensing of Environment. Ann Arbor, MI. 6-10 Oct. p. 1093-1100.

Results of a timber resource inventory for the Plumas National Forest (465,000 HA) in California are reported. The survey was based upon manual and automated analysis of LANDSAT-1 and supporting aircraft and ground data using stratified multistage sampling techniques. The survey was completed in six months' time and estimated a number of parameters. Cubic meter volume was estimated to be 167 m3/HA with a sampling error of 7.8 percent.

14 TITUS, Stephen J., Lee C. Wensel and Robert N. Colwell.
1977. Development of Sampling Design to Use with Remotely Sensed Data for National Resources Inventories. Final Report, U.S.F.S. Coop. Agreement No. 16-640-CA, Dept. of Forestry and Natural Resources, College of Natural Resources, University of California, Berkeley, CA 94720, 205 pp.

This report documents procedures, results, and recommendations for modifying sample survey systems implemented by the U.S. Forest Service to assess renewable natural resources at the national and regional level. Western Washington is the regional area to which the study was addressed. Particular emphasis is given to the role of remote sensing.

15 TUELLER, Paul T., Garwin Lorain, and Ronald M. Halvorson.
1973. Natural Resource Inventories and Management Applications in the Great Basin. ERTS-1 Symp., Wash., D.C., Dec. 10-14, 1973. p. 267-290.

Familiarity with landform, tone, pattern, and other converging factors and with multidate imagery available through utilization of ERTS-1 data has allowed the acquisition of several statewide inventories of natural resource features not previously completed. Nevada's vegetation has been mapped from ERTS-1 by the following categories: Southern Desert Shrub, Salt Desert Shrub, Northern Desert Shrub, Pinyon/Juniper Woodland, Mountain Brush, Aspen, Meadows and Marshlands, Wheatgrass Seedings, Phreatophytes, and cropland. Dynamic characteristics of the landscape were studies. Sequential ERTS-1 imagery was useful for mapping vegetation. Following vegetation phenology changes, monitoring changes in lakes and reservoirs, determining changes in surface mining use, making fire fuel estimates and determining potential hazard, and mapping the distribution of rain and snow events.

16 TUINOF, N. B. and G. M. Nicholls.
1978. Integrated Wildfire and Forest Inventory Management Information System. Forestry Chronicle 54(3):152-155.

17 TURCOTT, George L.
1977. BLM on Coordinating Resource Planning. In Rangeman's Journal 4(6):172-173.

Federal Land Policy and Management Act (FLPMA) sets the stage for managing public lands. This Act mandates BLM action and public participation. This means that any plan resulting from the BLM mutual efforts must meet the test of the land use planning system.

U

01 UNESCO.
1968. Aerial Surveys and Integrated Studies (Natural Resources Research N6) Proc. of the Conference, Sept. 21-28, 1964, Toulouse, Fr. 575 p.

The papers presented at the conference dealt both with the methods of ensuring the best use of aerial photographs in the study of geology, vegetation, hydrology, ecology, geomorphology, soils, etc., and with the application of those methods to integrated surveys carried out all over the world and, in particular, in Australia, Africa, and Latin America. Selected papers are indexed separately.

02 UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO)
1973. International Classification and Mapping of Vegetation. Printed by Imprimeries Populaires de Geneve. 93+ p.

The following classification is to provide a comprehensive framework for the more important categories to be used in vegetation maps at scales of 1.1 million or smaller. While the classification is intended primarily for the preparation of new maps, it may also be used for transforming existing vegetation maps into this system. The categories in this classification are units of vegetation, including both zonal formations and the more important and extensive azonal and modified formations.

The UNESCO classification of vegetation can be described as being basically physiognomic-structural in character with supplementary ecological information integrated into its various categories and applicable to natural and semi-natural vegetation.

03 U.S.D.A.
1974. Land Use Planning Assistance Available Through the United States Department of Agriculture, U.S.D.A. Rept. Feb 74. 54 p.

More than 80 U.S.D.A. programs that influence land use decisions are described for reference use by local, county, and state people involved in land use planning. The programs either furnish inventory data on natural resources--soil, water, plants, and animals--or they make available a wide range of advisory, financial, or technical assistance, program topics include: (1) inventories of lands and natural resources-soil surveys, water supplies, aerial photography, and forest surveys; (2) land uses--watersheds and rivers, conservation and environmental improvement of farm and forest lands, programs for forests, wildlife, and recreation, agricultural production programs, and financing programs related to land use; and (3) land use research and education-land use policy education, environmental policy education, natural resource planning assistance, alternative land uses, and research implementations. (3 maps, 36 photos, 1 table)

04 U.S.D.A.
1978. National Working Conference, National Program of Research for Forests and Associated Rangelands. Results of the Plenary Session. January 18, 1978, Washington, D. C. p. 57. U.S.D.A.

Summarize the results of a nationwide effort to determine research needs. Multiple resource inventory research was identified as being one of the fields needing the most urgent attention.

05 U.S.D.A. FOREST SERVICE.
1958. Techniques and Methods of Measuring Understory Vegetation. Proc. of a Symposium at Tifton, GA. U.S.D.A. For. Serv., South. Forest Exp. Stn. & Southeast Forest Exp. Stn. 174 p.

The four major sections are (1) measuring herbage production and utilization, (2) measuring plant cover and composition, (3) related forestry problems, and (4) statistical problems.

06 U.S.D.A. FOREST SERVICE.
1972. The Nation's Range Resources, A Forest-Range Environment Study. Forest Resource Report No. 19, Supt. of Doc., U.S. GPO, Washington, D. C. 147 p. illus.

A system was developed for categorizing the forest and range area of the 48 conterminous United States into major ecosystems. These ecosystems were divided according to ownership, productivity, and condition into resource units, land area determined, and 1970 grazing production and 21 other outputs estimated. Yield of all

outputs in each of 956 resource units was estimated under six simulated levels of management. Demand was derived for livestock grazing and estimated for other forest-range outputs. An analytical system was developed with a minimum cost objective function and used to suggest management mixes to achieve national goals for forest-range livestock production at minimum cost when modified by environmental or social considerations. Policy alternatives for meeting long-run policy objectives were evaluated and conclusions drawn about forest-range grazing.

07 U.S.D.A. FOREST SERVICE.
1974. Total Resource Information System. Pacific Northwest Region (R-6) Portland, Oregon, November.

08 U.S.D.A. FOREST SERVICE.
1974 to 1976. Analysis of Computer Support System for Multi-Functional Planning, Vol. 1, 2, 3, and 4. Management Sciences Staff, U.S.D.A. Forest Service, Berkeley, CA.

The study pertains to the existing Forest Service computer support systems for multi-year program planning and land use planning, with particular emphasis on forest level planning. The study objectives are to determine:

1. The types of planning situations for which existing systems are to be used.

2. The utility of these systems.

3. The applicability and transferability of these systems to a variety of locations.

4. The gaps wherein no computer support systems for planning exist or are being developed, and priorities for closing the gaps.

5. The criteria for managing systems development including alternative strategies for implementing systems and requirements for training users.

09 U.S.D.A. FOREST SERVICE.
1975. RPA, the Nation's Renewable Resources - An Assessment. 345 p. Forest Service, U.S.D.A., Washington, D. C.

In recent years, many and rapid changes have taken place in the use of American forest and range lands and inland waters. Consumption of nearly all products of these lands and waters has been rising rapidly, and there has been increasing emphasis on management for multiple purposes. There has also been growing concern about the forest and range environment and the need to preserve and enhance scenic and esthetic values.

An effort has been made to recognize changes that have been taking place and likely impacts on future supplies of forest, range, and inland water products. For example, constraints associated with multiple use management and protection of the environment have been taken into account in projecting timber supplies from the National Forests. Projections for private ownerships also recognize the importance of nontimber objectives and what timber harvests might be limited. Specific allowances for continuing transfer of commercial timberlands to other uses were made on all ownerships.

The analysis in this study covers the next four and a half decades. For the longer run, with growing population pressure on the environment and non-renewable stocks of ores and fuels, renewable resources could become increasingly more important. Thus, in appraising the needs for programs and the urgency for action, consideration must be given to the situation beyond the period covered in this report. With proper management, the output of renewable forest and range products can, in time, be greatly increased and higher levels of output maintained for future generations.

10 U.S.D.A. FOREST SERVICE.
1975. The Nation's Renewable Resources - An Assessment. Forest Service. Forest Resource Report No. 21. 232 p.

A comprehensive study of the renewable resources of forest, range and inland waters. It shows that the Nation's demand for outdoor recreation, wildlife and fish, and forest-range grazing, timber, and water have been growing rapidly. These demands, in response to increases in population, economic activity, and income, continue to rise in decades ahead. It includes statistical data on the ownership, condition, and productivity of the Nation's 1.6 billion acres; recent changes in the lands and trends in the consumption and prices of major products; the prospective demand, supply and price outlook. Data are also presented on international trade in forest and range products and the forest resources of important trading countries. Lastly, the kinds of data and scientific information needed to provide an adequate quantitative basis for future assessments are studied.

11 U.S.D.A. FOREST SERVICE.
1976. Land System Inventory Guide. U.S.D.A. Forest Service, Northern Region, Missoula, MT.

This is a handbook on a narrow section of the whole land system inventory scheme--the landtype--since this is the level at which the inventory is presently being conducted. Extensive areas of National Forest land in Region 1 have already been inventoried at the landtype level. Experience in Region 1 has demonstrated that an analysis of the inferred geomorphic history of landscapes and the formation of mapping units based on this analysis as defined in terms of low-order stream features, local relief and slope shapes, produces mapping units with predictable reoccurring patterns of soils and habitat types. This procedure then facilitates the mapping of large areas of land using photo interpretation with a minimum of field checking. Landtype inventories have been an ideal tool for inventorying of land potential in steep, forested, mountainous terrain. They provide a maximum of land information with a minimum of investment. The kind of information produced and its reliability is adequate for most management decisions at the resource allocation level.

12 U.S.D.A. FOREST SERVICE.
1978. Resources Evaluation Handbook 4809.13. Draft, Washington, D. C. 65 p.

This handbook provides national technical directions for Resources Evaluation. It covers analysis, supporting resources inventories and related studies. Provision is made for supplementation at the Station level for adding regional direction. This handbook, with regional supplements, along with Resources Evaluation Research Work Unit procedures handbooks (FSH 4809.21, 4809.22, 4809.23) and study plans provide complete documentation of the work of Resources Evaluation.

13 U.S.D.A. SOIL CONSERVATION SERVICE.
1971. Basic Statistics of the National Inventory of Soil and Water Conservation Needs. U.S.D.A. Stat. Bul. 1461. p. 211.

Contains the basic statistics of the inventory. It includes data about four major aspects of the Nation's agricultural land, as follows: (1) Land capability, by class and subclass; (2) land use, and expected land in each land use; and (3) small watershed projects needed.

14 U.S.D.A. SOIL CONSERVATION SERVICE.
1975. Land Resource Regions and Major Land Resource Areas. U.S.D.A. Agric. Handbook 296.

Publication and accompanying map were assembled and organized available information about the land as a resource for farming, ranching, forestry, engineering, recreation and other uses. Three land resource categories are involved: land resource units, major land resource areas and land resource regions. The dominant physical characteristic of each land resource region and area are: land use, elevation and topography, climate, water and soil.

15 U.S.D.A. SOIL CONSERVATION SERVICE.
1976. National Range Handbook; Rangeland, Grazeable Woodland, Native Pasture. U.S.D.A. Soil Conservation Service, Misc. Paging.

This handbook deals with the study, inventory, analysis, treatment, and management of the natural resources comprising native grazing land ecosystems. The compexity of native grazing land, the multiple benefits it affords, its interrelationship with forest land and cropland, and its related watershed and wildlife values require an interdisciplinary approach in planning and implementing resource conservation programs.

The criteria and procedures in this handbook are ecosystem oriented, not in a mathematical modeling sense but in an applied sense, with full consideration for:

--Physical environment embracing soils, topography, and climate;

--Biological potential including plants and animals;

--Primary productivity of present and potential plant communities;

--Secondary production from animal populations (wild as well as domestic);

--Alternative for manipulating vegetation, soils, and animals to reach specific management objectives that will produce the goods and services needed by rural families, communities, and society as a whole;

--Standards for conservation treatment measures to reach management objectives and protect basic resources; and

--Economic considerations.

16 U.S.D.I., BUREAU OF LAND MANAGEMENT.
1976. Integrated Habitat Inventory and Classification System. Manual 6602. Washington, D. C. Misc. Paging, U.S. Dept. of Interior.

A manual covering the mapping and classification of vegetation for wildlife habitat.

17 U.S.D.I., BUREAU OF LAND MANAGEMENT.
1978. Soil Vegetation Inventory Method. Draft Manual 1731. Washington, D. C. (Mar.) Misc. Paging.

A manual describing the mapping, sampling and measurement techniques to collect basic soil and vegetation information for vegetation allocation.

18 U.S.D.I., FISH AND WILDLIFE SERVICE.
1977. Classification, Inventory and Analysis of Fish and Wildlife Habitat: The Proceedings of a National Symposium: FWS/OBS-78/76. 604 p.

Forty papers presented during a national symposium in Phoenix, AZ.

19 U.S.D.I., FISH AND WILDLIFE SERVICE.
1977. Comparison of Selected Operational Capabilities of Fifty-four Geographic Information Systems. FSW/OBS-7754. Fort Collins, CO. 24 p.

Presents the results of the initial evaluation of the "off the shelf" computer software available, based on user needs and the system design for the Service.

20 U.S.D.I., FISH AND WILDLIFE SERVICE.
1977. Natural Resource Geographic Data Bases for Montana and Wyoming. FSW/OBS 77/55. Fort Collins, CO. 64 p.

Assesses the availability and nature of 400 existing data compilations to determine their relative value as data sources.

21 U.S.D.I., FISH AND WILDLIFE SERVICE.
1977. User Needs Assessment for an Operational Geographic Information System. FSW/OBS 77/21. Fort Collins, CO. 79 p.

Documents the results of a five-month survey of user needs in the Service's Region 6 (Rocky Mountain and Great Plains area). Potential users characterized lodical groups of data, and representative user groups were identified.

22 U.S.D.I., FISH AND WILDLIFE SERVICE.
1978. Map Indexing System User's Manual. FSW/OBS 78/64. 24 p.

The manual describes the map indexing system (MIS) component of the U.S. Fish and Wildlife Service's Geographic Information System. It explains how spatially related data which is used and needed by the Fish and Wildlife Service can be catalogued and filed in a comprehensible, partially manual, partially automated, library system. The manual contains a general overview of MIS components, directions on using the MIS to evaluate data bases, and suggestions on where to search if data is not in the system. An appendix provides examples of system commands.

23 UTAH COOPERATIVE WILDLIFE RESEARCH UNIT.
1976. Guidelines for Line Transect Sampling of Biological Populations. Prepared for U.S. Fish and Wildlife Service - Office of Biological Services by Utah Cooperative Wildlife Research Unit, Utah State University, Logan, UT.

Proper estimation of density via transect sampling schemes involves a mix of basic statistical sampling theory and knowledge of the biology of the population under study. Ten important points to consider in designing a survey are suggested.

V

01 VAN GENDEREN, J. L.
1973. An Evaluation of EREP (SKYLAB) and ERTS Imagery for Integrated Natural Resources Survey. Sheffield Univ. (England) Dept. of Geography. NASA CR-139252. 25 p.

The author has identified the following significant results. An experimental procedure has been devised and is being tested for natural resource surveys to cope with the problems of interpreting and processing the large quantities of data provided by SKYLAB and ERTS. Some basic aspects of orbital imagery such as scale, the role of repetitive coverage, and types of sensors are being examined in relation to integrated surveys of natural resources and regional development planning. Extrapolation away from known

ground conditions, a fundamental technique for mapping resources, becomes very effective when used on orbital imagery supported by field mapping. Meaningful boundary delimitations can be made on orbital images using various image enhancement techniques. To meet the needs of many developing countries, this investigation into the use of satellite imagery for integrated resource surveys involves the analysis of the images by means of standard visual photointerpretation methods.

02 VAN ROESSEL, Jan W., Phillip G. Langley, and Terrell D. Smith. 1978. TIMBER-PAK--A Second Generation Forest Management Information System. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 360-374.

TIMBER-PAK is a new forest management information system. It is a polygonal disk-stored system with a data definition method and a query language. Design and use features are described. Graphical examples of digitizing, updating, slope class generation and querying are provided.

03 VAN SICKLE, Charles C.
1978. An Overview of Regional Forest Inventory Systems in the United States. International Union of Forest Research Organization Theme: National Forest Inventory. Proceedings, Bucuresti-Romania p. 89-98.

The nationwide forest inventory program in the U.S. was authorized by the U.S. Congress in 1928. Renewable Resources Evaluation, as it is now called, has been in operation continuously since the 1930's and has provided information for State, regional, and national timber assessments. The inventory is conducted from seven regional locations. Each inventory project is responsible for collecting information about forest conditions on both public and private lands but available data from existing administrative inventories are used when appropriate. The inventory design differs from one region to another. Essentially it is a double-sampling-for-stratification design, consisting of a photo interpretation phase and a smaller set of clusters of permanent ground plots. Inventories are processed by specialized data compilation programs developed for this specific purpose. Current and anticipated information needs are outlined.

04 VAN SICKLE, Charles C.
1978. Forest Resource Inventory: A Moving Target. Paper Presented at Eighth World Forestry Congress 16-28 Oct., FID-I/16-11 8 p. Jakarta, Indonesia.

Forest resource information needs change with the level of industrial development, with the condition of the resource, with the development of industrial technology, and with the economic and political situation that prevails. Because the inventory process from conception to completion often takes several years, it is necessary to anticipate future information needs when inventories are planned.

Forest inventories may furnish data for many kinds of assessment. Conversely, assessments may draw information from several inventories or data sources. It is helpful in inventory planning to analyze the kinds of assessments and organizational application for which the resource information will be used.

The development of resource inventory has been swift in recent years. Sampling system, remote sensing techniques, data processing, and mapping have all achieved major breakthroughs. But more sophisticated techniques also demand more refined skills from the user. It is essential to match the level of sophistication in the inventory with the needs and skills of the user.

05 VASILEVSKY, Alexander and Burton L. Essex.
1978. An Accurate Way to Select Sample Plots on Aerial Photos Using Ground Control. In Proceedings 1977 Midwest Forest Mensurationist Meeting, U.S.D.A. Gen. Tech. Rept. NC-46. U.S.D.A. F.S. North Central Experiment Station, p. 28-29.

Assembled mosaic system allows us to locate plots systematically on the aerial photos, which minimizes the bias due to photography in photo plot sampling. We still cannot entirely eliminate small differences of relief and some distortion on the edge of the photos, but we do eliminate costs of the map-ground transfer process and believe that our statistical results are realistic.

06 VEENENBOS, J. S.
1957. Methods and Cost of Soil and Land Classification Surveys When Using Aerial Photographs: African Soils, 4:122-135.

07 VIKSNE, A., T. C. Liston and C. D. Sapp.
1970. SLR Reconnaissance of Panama: Photogramm. Eng., 36(3):253-259.

SLR (Side-Looking Radar) was successfully used in lieu of optical photography for reconnaissance of the Darien Province of Panama and parts of Northwest Colombia, and for the construction of geoscience products thereof. An AN/APQ-97 side-looking radar was used to produce high-resolution imagery of an area containing approximately 6,600 square miles in 4 hours of flying time--an area, furthermore, that is almost perpetually cloud covered. The SLR imagery was used to prepare an uncontrolled mosaic and a series of geoscience overlays, including: Surface Drainage, Surface Configuration, Vegetation, Engineering Geology. The results of this study are believed to be unique in that they provide the first complete overview of Darien Province, thereby demonstrating the capability of SLR to gather geoscience data in an area that is notorious for the difficulties that its persistent cloud cover poses for the acquisitoin of usable conventional optical aerial photography.

08 VOLD, Terje.
1978. Reconnaissance Biophysical Soil Inventories in British Columbia: A Case Study of the Northeast Coal Area. In Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop. Gen. Tech. Rept. RM 55,
Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A. Fort Collins, CO. p. 403-411.

The biophysical soil classification scheme used in the Northeast Coal Area allows for rapid inventory of large and remote tracts of land. The inventory permits regional evaluation of biophysical resource capabilities for various land uses as well as general assessment of particular development proposals.

W

01 WAGAN, J. Alan.
1976. Land-Use Planning: A View from Holland. Jour. of Forestry, 774(1):13-17.

Participation in a Dutch planning study suggested that public resource decisions require input from at least five groups: diverse specialists, interest groups, analysts, plan builders, and decision makers. Integrating these inputs requires emphasizing meanings rather than details, careful distinction between facts and values, and a defensible hierarchy of values. A computer mapping technique for identifying and defining alternatives is described.

02 WAGNER, T. W., and Fernandez, J. C.
1977. Applications of Landsat Data to the Integrated Economic Development of Mindoro, Philippines, In Internat. Symp. on Remote Sensing of the Environment, 11th, Ann Arbor, Mich., 1977, Proc.: Ann Arbor, Mich., Environmental Research Inst., 2:1375-1380.

Landsat data is seen as providing essential up-to-date resource information for the planning process. As part of the USAID-funded grant, Landsat data of Mindoro Island in the Philippines was processed to provide thematic maps showing patterns of agriculture, forest cover, terrain, wetlands and water turbidity. A hybrid approach using both supervised and unsupervised classification techniques resulted in 30 different scene classes which were subsequently color-coded and mapped at a scale of 1:250,000. In addition, intensive image analysis is being carried out by the various Philippine government agencies in evaluating the images.

The images, maps, and aerial statistics are being used to provide data to seven technical departments in planning the economic development of Mindoro. Multispectral aircraft imagery has been collected to compliment the application of Landsat data and validate the classification results.

03 WALDRON, Bobby Ray.
1978. Optimal Parameter Estimation in Multiple Sample Problems, Ph.D. Thesis, Texas A & M University. 61 p.

A general estimation technique is developed for combining information in order to obtain optimal estimates of parameters by utilizing multiple independent samples, each of which may contain information about some or all of the parameters. In addition, a sequential technique is given for sequentially computing the Cramer-Rao lower bounds on the variances of the estimates.

The above technique is shown to be a sequential method for solving the maximum likelihood equations for certain classes of estimation problems. The procedure is also shown to have the optimal properties of consistency, and asymptotic efficiency under very general conditions regardless of the basic underlying distribution.

04 WANDELER, H.
1977. Aufgabe und Bedeutung Integraler Forstinventuren aus der Sicht des Eidgenossischen Oberforstinspektorates; Tasks and Importance of Integrated Forest Inventories from the View of the District Forest Inspector. J. For. Suisse. 128 (1): 30-33.

05 WARD, Joe H., Jr.
1963. Hierarchical Grouping to Optimize an Objective Function. American Statistical Association Journal 58:236-244.

A procedure for forming hierarchical groups of mutually exclusive subjects, each of which has members that are maximally similar with respect to specified characteristics, is suggested for use in large-scale (n>100) studies when a precise optimal solution for a specified number of groups is not practical. Given n sets, this procedure permits their reduction to n--1 mutually exclusive sets by considering the union of all possible n(n--1)/2 pairs and selecting a union having a maximal value for the functional relation, or objective function, that reflects the criterion chosen by the investigator. By repeating this process until only one group remains, the complete hierarchical structure and a quantitative estimate of the loss associated with each stage in the grouping can be obtained. A general flowchart helpful in computer programming and a numerical example are included.

06 WARE, Kenneth D.
1975. Resource Inventory, Land Classification and Land-Use Planning: the Relationships. In America's Renewable Resource Potential-1975: The Turning Point. Proc. Soc. Am. For., p. 332-342. (Washington, D. C. Sept. 28-Oct 2, 1975)

A main objective in this paper is to sketch a construct by which to relate the information required for land-use planning and resource management decisions to land classification systems (such as described earlier) that characterize the productive capability of the land for various desired outputs when these systems are applied with a recurring inventory of the land and the associated resource stock. Secondly, it will be useful briefly to critique the present state-of-the-arts in inventory and land classification against this construct. And indoing this it will be desirable to indicate how the subject matter of earlier papers in this panel fits the construct.

This will require a brief discussion of land-use planning and management decision processes and the specification of information needs. Then we shall need to recall briefly the criteria for and the uses of land classification systems. Next, we must consider the role of the inventory (data capture) process in applying sample selection rules, observation, and analysis and inference techniques along with the land classification system, to provide the desired information. And finally, we shall discuss some examples and current activities aimed toward development and application of integrated land classification and resources inventory systems.

07 WARE, Kenneth D.
1978. Principles for Integrating Inventories of Renewable Resources: Moderator's Comments. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55. Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO p. 260-266.

Several principles are paramount for designing systems to inventory renewable resources on a recurring basis. Adequate design requires specification of (a) objective (analytic vs. enumerative, managerial vs. descriptive, etc.), (b) alternative schemes for selection and estimation, (c) cost-effectiveness criteria, (d) techniques of field observation, (e) common units of measure, and (f) procedures for estimating interaction relationships among resources.

08 WARE, Kenneth D. and Jay M. Hughes.
1973. Information for Resource Management Decisions I: Inventory Systems, Design and Analysis. In Foresters in Land-Use Planning. Proceeding, 1973, National Convention, Society of American Foresters. p. 122-139. (Portland, Oregon, September 23-27, 1973).

In summary, we have:

1) sketched a framework for the role of information and inventory systems in management decision;

2) mentioned various levels of decision in hierarchal structure;

3) discussed inventory systems from the standpoint of setting objectives, criteria, and determining alternatives;

4) proposed systems designed to determine management response trajectory;

5) discussed the concept of value or utility of information; and

6) considered several inventory design alternatives, basing our choices on the general utility of the principles embodied in them in cost-effectively providing information for resource management decisions.

09 WATT, K. E. F.
1968. Ecology and Resource Management. McGraw-Hill, Inc., New York, 450 p.

This book has been written to satisfy two objectives. First, to present a general theory of resource management that will be useful in dealing with all kinds of resource management problems, from oceanic fisheries to rodent control, to management of forests, rangelands, savanna, or orchards. There is a developing science of resource management per se even though there is so little contact between the various resource management professions that this fact is often veiled. However, all the resource management fields are related to each other by dependence on a common science: ecology; by a common problem: the optimization, or "extremum problem" of mathematicians; and by the need for a common set of tools: scientific sampling, statistical and mathematical analysis, the intellectual procedures of operations research and systems analysis and computers.

The second objective is to explain a set of techniques that are ushering in an entirely new era in the management of complex resource optimization problems; particularly interested in showing the great pertinency of certain new methods of applied mathematics and computer simulation for solving problems of enormous compexity in this field. To attain these objectives, a number of somewhat novel procedures are adopted in this book.

10 WAY, Douglas S.
1968. Air Photo Interpretation for Land Planning. Cambridge, Mass.: Harvard Univ., 137 p.

To identify specific landforms on aerial photographs, five basic elements are examined: vegetation and land use, the drainage pattern, topography, erosion gullies and photographic tone. Once the land form is identified, certain inherent characteristics resulting from its formation, age, and environmental climate can be measured. Consequently, the specific site capabilities can be analyzed and compared. This enables design development alternatives to be derived, based upon accurate, fast, and current data.

11 WEBSTER, R., and P. H. T. Beckett.
1970. Terrain Classification and Evaluation Using Air Photography: A Review of Recent Work at Oxford: Photogrammetria, 26(2/3):51-75.

A potential was required for predicting soil and terrain conditions over large areas from sparse ground information. To make the most use of this information it must be stored and indexed according to the kind of terrain to which it refers, and the kind of terrain

must be recognizable on air photographs with limited ground check. The physical storage, indexing and retrieval according to land type of useful terrain information is seen as a formal analogue of the intuitive mental procedures already used by photo interpreters.

A land classification consisting basically of land facets, homogeneous classes, and land systems, patterns of recurrent land facets, is described. In a series of trials in south central England the classification was found to be comprehensive and its land facets consistently recognisable. Land facets were shown to be sufficiently homogeneous for many practical purposes.

The classification was further tested in Uganda, Kenya, Tanzania and Swaziland where maps of land systems but not land facets were produced. To enable the user of maps to identify land facets within land systems a module was devised bearing descriptions of the land system and all its component land facets, a block diagram of the land system to show the relations between the land facets, and annotated air photographs of sample areas.

12 WEISZ, N. Reuben and Ross Carder.
1975. Development of Land Use Planning and Transportation Planning System for National Forest Management: A Status Overview. In Systems Analysis and Forest Resource Management: Proceedings Workshop by SAF, University of GA, Athens, p. 87-104.

This paper describes how emerging computer-aided planning support systems can be made operational. Some existing systems, linkages between systems and interfaces between systems and the U.S.D.A. Forest Service planning and decision making process are examined. Current systems development problems are surveyed. A few solutions are suggested.

13 WENDT, George E.
1978. A Basic Inventory That Works. Rangeman's Journal 5(5):164-166.

In the Intermountain Region the procedure developed to provide land base information for integrated environmental studies is called the Land Systems Inventory. This inventory considers the effects resulting from geologic and climatic history, soils, hydrology and plant ecology. Basic Land Systems units such as land types or land type associations can be grouped to reflect management opportunities and limitation and indicate management direction for planning purposes. This method aggregates, the landtype association into land capability groups, which are areas of land having similar characteristics, suitabilities, potentials and response to us.

14 WENDT, George E., R. A. Thompson, and K. N. Larson.
1976. Land Systems Inventory--Boise National Forest, Idaho. U.S.D.A. Forest Service, Region 4, 54 p.

The Land Systems Inventory is an ecological inventory which provides basic information for management decisions regarding allocations and uses of National Forest lands. The development, concept, and uses of the Land Systems Inventory being used in the Intermountain Region are discussed. Basic characteristics and evaluations at the landtype association level of the system are given for major units on the Boise National Forest in Idaho. Discussions of use and application of this information emphasize the value of integrating the land systems units with other basic inventories. Development of land capability groups from landtype associations is used as an example of one way to make use of this basic information. Relationships of levels of the system and landtype associations to each other are given in illustrations. Tables containing summary characteristics and capability ratings are given. A colored map illustrating the capability groups and landtype associations on the Boise National Forest is presented in the appendix.

15 WENSEL, Lee C.
1974. Selection Probabilities in Multi-Parameter Sampling. In Proc. Inventory Design and Analysis Workshop, Colorado State University, Fort Collins, CO, p. 357-367.

In the following development a procedure is given for determining the optimum selection probabilities when more than one variable is of interest. A brief computational example is given and the application of this procedure is discussed in the case of list sampling.

It is then noted that if the variables of interest are not positively correlated, and the correlations between the "first estimates" and the variables are not "high", variable probability can be less efficient than simple random sampling (SRS) without the use of auxiliary variables. In such cases, regression estimates are to be preferred.

Finally, when the appropriate auxiliary information is available, a regression estimator using one or more variables is far superior to variable probability models in multi-parameter sampling problems.

16 WENSEL, Lee C.
1977. Wildland Resource Sampling. Draft. Univ. of Calif. Various Paging.

Text for junior-level course work focusing on methods and procedures used to obtain estimates of the current and probable future state of the forest, range, watershed, and recreation lands, including the characteristics of the vegetation existing on these lands, the animals that live on the land, and the people who use the land for recreation.

17 WENSEL, Lee C. and Hugo, J. John
1969. A Statistical Procedure for Combining Different Types of Sampling in a Forest Inventory. Forest Science 15(3):307-317.

A procedure to permit the simultaneous use of more than one primary sampling unit (PSU) to give greater flexibility in a forest inventory is present. Of primary interest is the case where n_1 independent samples of a_1 are selected with probability proportional to frequency (ppf) and n_2 independent samples of size a_2 are selected with probability proportional to size (pps), where a_1 is the plot area in acres and a_2 is the average plot area in acres. The resulting estimator Z of the population mean is derived as a function of the sample means for each sampling unit and appropriately chosen weights. The variance of this estimator is examined for various choices of weighting functions.

18 WERTZ, W. A., and J. F. Arnold.
1972. Land Systems Inventory. U.S.D.A. For. Serv., Intermountain Region, Ogden, UT. 12 p.

The land inventory system accommodates the idea of land as the basic medium of management and at the same time fits within the framework of the logic for classification. Commensurate fits of data levels and planning applications are matched for each category. The system is intended to permit for an identification of integrated ecological systems on a permanent locatable basis. It provides units which can be interpreted for the greatest number of applications for both limited and multipurpose uses.

This system embodies the universally applicable features of designs for land classification developed by a cross-section of the world's earth scientists. It is simplistic and workable. It is not, however, considered to be complete as presented. It is a skeleton, an early approximation. It is hoped that others will expand it,

reveal its inadequacies, and fill in the gaps. To this purpose the offer is extended to those engaged in the many facets of earth science studies and land use planning activities for testing and critique of the system.

19 WETTON, E. A. F.
1975. Planning Tools in the British Columbia, Forest Service. In Proceedings. Systems Analysis and Forest Resource Management. Soc. Amer. Foresters and University of Georgia, 105-111.

Discusses various planning projects including Resource Folio System, Springbrook Project, and Higher Value Added Studies.

20 WHEELER, Alan Clement.
1968. Multiproduct Inventory Models with Set-Up Cost. Ph.D. Thesis, Stanford, University. 137 p.

The multiproduct version of the (s,S) stochastic inventory model with periodic review is investigated. In the general formulation it is shown that if an optimal policy exists then there is an optimal Markov policy. Thenceforth, it is assumed that the one-period expected cost function is quasi-convex and continuous.

It is shown that every finite-horizon problem has an optimal (sigma, S(x)) policy, characterized by sets sigma of inventory levels from which orders are placed and functions S(x) determining the levels after ordering. Because of the generality of such a policy, conditions are given which ensure optimality of policies with stronger characterizations, i.e., each sigma and S(x) have a more specific form. Examples are given, however, which demonstrate that there need not be optimal policies as strongly and simply characterized as one-product (s,S) policies.

21 WHEELER, Alan Clement.
1973. Useable Multiproduct Inventory Policy. 44th Nat. Meet. Operations Res. Soc. of Amer. San Diego, CA. 12-14 Nov.

22 WIANT, Harry V. Jr.
1977. An Illustration of List Sampling. Resource Inv. Notes BLM 6, p. 1-5.

The use of list sampling is discussed. An example and formulas given.

23 WIANT, Harry V., Jr. and Edwin D. Michael.
1978. Potential of 3P Sampling in Wildlife and Range Management. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 304-306.

Procedures used in 3P sampling, which selects sampling units with a probability proportional to predicted size and adjusts estimated values by the average measured-to-estimated ratio, are described. Possible applications in wildlife and range management inventories are discussed.

24 WIEDEL, J. W. and Richard Keeckner.
1974. Using Remote Sensor Data for Land Use Mapping and Inventory--A User Guide. U.S. Geo. Surv. Interagency Rept. 253, 12 p.

25 WIKEN, Ed B.
1978. The Role of National and International Coordination in Ecological Land Classification. Integrated Inventories of Renewable Natural Resources: Gen. Tech. Rept. RM 55, Rocky Mt. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 183-191.

Coordination, both in an informal and formal capacity, serves an important role in the development of integrated land surveys. This role is exemplified in many of the circumstances surrounding the ecological land classification approach. In the past, coordination provided the means to capitalize on experiences and achievements of national and international sources. Through the Canada Committee on Ecological Land Classification and its members, the continuance of coordination will encourage: the transfer of research and technology, cooperative action to problem solving, efficient allocation of financial resources, the standardization of methods, and an understanding of the work.

26 WIKEN, Ed B. and G. Ironside.
1977. The Development of Ecological (Biophysical) Land Classification in Canada. Landscape Planning. 4:273-275.

Ecological (biophysical) land classification is but one of many forms of land survey found in the world. This overview discusses its development, recent trends and current status in Canada.

27 WIKSTROM, J. H.
1978. Developing Inventories to Support Resources Assessment. In National Forest Inventory Proc. IUFRO, Bucuresti, Romania. p. 113 - 121.

We need the kind of resource information that allows us to evaluate alternative uses of land singly and in combinations and to consider resource interactions and environmental impacts. Also, to effectively assess the resource situation, we need to analyze it at different levels of aggregation. We have no land classification system that is hierarchical in nature and that would accommodate analysis at different levels. The key question concerns more our approach to inventory than details of methods and procedures. As a minimum, we need a sampling approach that lends itself to integration with inplace or map information to facilitate dealing with resources and environment spatially. Further, our approach must allow for the integration of new classification information as it becomes available, permit poststratification and varying of sampling intensity, and allow use of new remote sensing sources. We are confronted with a problem that is not totally a research consideration. New information about the relationships and interdependencies of nature will help our understanding, but dealing with the inventory of renewable natural resources is more a matter for our reflective thinking.

28 WILLIAMS, H. David, Michael M. Yamada.
1975. Data Aggregation for Land Management Models - A Program Approach. In Systems Analysis and ForestResource Management Proceedings Workshop by SAF, University of GA, Athens, p. 336-350.

Cluster analysis can be used to aggregate land units into efficient data sets for land management models, by clustering the land units in the state variable space of the model. The error of aggregation is minimized. Data sets that are pre-stratified for a specific management purpose are aggregated by a dynamic programming algorithm of cluster allocation and formation.

29 WILLIAMS, R. S., Jr. and W. D. Carter, eds.
1976. ERTS-1 A New Window on Our Planet. U.S.G.S. Prof. Pap. 929. 362 pp. Washington, D. C.

The launch on July 23, 1972, of the first Earth Resource Technology Satellite (ERTS-1) and the subsequent launch of ERT-2 on January 22, 1975, were major steps forward in extending man's ability to inventory

the Earth's resources and to evaluate objectively his impact upon the environment. Examples presented in this book demonstrate ERTS' vast potential for inventorying resources, monitoring environmental conditions, and measuring changes.

30 WILSON, H. Lee and Edward V. Beard.
1952. The use of Aerial Photographs and Ecological Principles in Cover Type Mapping. J. Wildlife Mgmt. 16(3):320-326.

The writers propose to show how, through knowledge of ecological principles in conjunction with the use of aerial photographs, certain repetitive patterns of vegetation can be established which are adaptable to efficient and informative mapping of forest cover in mountainous terrain.

31 WILSON, S.
1974. Land Use/Resource Inventory Systems: An Information Paradigm. Texas A & M Univ., Coll. Station, TX. Amer. Jour. Agri. Econ. 56(5):1200.

The fundamental concepts of information theory are used to construct a conceptual framework for the creation and operation of land and/or natural resource inventory systems. Such a framework is the initial step in creating a general theory of inventory system. Several systems exist without a theory.

32 WITMER, Richard E.
1978. The U.S.G.S. Land Use and Land Cover Classification System. In U.S.D.A. For. Serv. Gen. Tech. Rept. RM 55. Integrated Inventories of Renewable Natural Resources - Proceedings of the Workshop. p. 178-182.

The U.S.G.S. land use and land cover classification system was devised to provide a logical framework when such information is derived from remote sensors as well as serving as the classification system to be used in a national inventory. The result is a combination of inductive logical processes (remote sensor image interpretation capabilities) and deductive logical processes (division of the landscape as realted to resource information needs).

33 WITMER, Richard E.
1978. U.S. Geological Survey Land-Use and Land-Cover Classification System. Jour. of Forestry. 76(10):661-665.

The land-use and land-cover classification system proposed for review in U.S. Geological Survey Circular 671 was devised to provide a logical framework for land-use and land-cover information derived from remotely sensed data as well as to serve as the classification system for a national inventory. Review comments from federal, state, local, and other potential users were incorporated into U.S.G.S. Professional Paper 964, the final version of the classification. The classification system is a combination of inductive processes (capabilities for interpreting remote-sensor images) and deductive processes (division of the landscape as related to resource information needs). Specifications have been devised in order to put it to use in a national inventory. To date, 11 states have participated in matching-funds cooperative agreements for land-use and cover mapping, and several federal and regional agencies are using the system, maps, and data.

34 WORLEY, David P.
1966. A Forest Inventory Approach to Multiple-Use Analysis. Soc. Amer. Forest. Proc. 1966:138-142.

The central objective is to provide information about a tract of forest land so that the one or two best management systems can be chosen from among a number of possibilities. Three sets of information are required as a basis for making the choice: (1) Information required to determine the suitability of the timber on the tract or portions thereof for specific potential management practices or systems; (2) information to provide a basis for estimating present and future production of multiple-use products; (3) information that provides a basis for estimating costs and immediate returns associated with implementing these management systems.

It is important to recognize that, while these objectives appear to be sweeping in scope, they are really quite limited. Other factors, unrelated to the forest or the surface of the tract, also affect management decision. Alternatives for water-yield improvement, for example, may be feasible only in certain precipitation zones or over particular geologic formations. Such factors are not considered in this forest inventory, but may provide strata which affect inventory detail.

35 WUNDERLICH, R. Eugene.
1978. Integration of Data Information Between Agencies. Integrated Inventories of Renewable Resources: Gen. Tecn. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO, p. 390-391.

An index file has been established in Denver to provide a reference to the availability of data information. This is an automated file that can be accessed by remote terminal. The purpose of the file is to provide a simple and quick location of where to find certain kinds of data information. Although the initial file is small, the need is large to establish this kind of file.

Y

01 YOUNG, Harold E., Theodore C. Tryon, and Clifford L. Swenson.
1978. Current and Future Biomass and Resource Inventory Techniques. Integrated Inventories of Renewable Resources: Gen. Tech. Rept. RM 55, Rocky Mtn. Forest and Range Exp. Stn., For. Serv., U.S.D.A., Fort Collins, CO. p. 469-473.

Completion of the first biomass-inventory of 63,251 acres of public lots in Maine in the Spring of 1976 led to an immediate biomass inventory of 500,000 acres of private forest land in Maine. In 1976 a combined biomass-volume inventory of 1,800,000 acres of forest land managed by Seven Islands Land Company in Maine began that includes pre-field reconnaissance, three weight tables for every tree and shrub species, a stand information retrieval system, biomass site productivity and participation of land owner foresters in the inventory process to maximize their use of the inventory when completed. Suggestions are presented by expanding biomass inventories to provide information for sophisticated forest management that will be both expected and required in the near future.

Z

01 ZAITZ, Carl E.
1969. Resources and Cadastral Mapping of Panama: Photogramm. Eng., 35(8):772-778.

A four year program of resources mapping and a rural cadaster of the more populous part of the Republic of Panama was completed in 1969. Aerial photography was performed for most of the area under extremely limited weather conditions. Aerial photographs, mosaics and enlargements were the basic tools for the project,

and the results of photo-interpretation and field work were compiled on over 5,000 maps. A system of providing land titles with property descriptions delineated on aerial photos was designed. The routine of the job was interrupted by a spectacular search and rescue mission when project officials were crash-landed in a remote area.

02 ZIEMER, Robert R. and David Strauss.
1978. A Statistical Approach to Instrument Calibration. A Special Report, U.S.D.A. Forest Service, Washington, D.C. 25 p.

A statistical approach has been developed to determine if new calibration lines are necessary for accurate use of the instrument The example to be given outlines calibration of a borehole inclinometer designed to monitor the deformation of mountain slopes. The same statistical approach can be used with other instruments such as the neutron soil moisture probe, solar radiometer, suspended sediment sampler, or the precipitation gauge.

03 ZOLTAI, S. C.
1978. Ecological Land Classification Projects in Northern Canada and Their Use in Decision Making. In Applications of Biological (Biophysical) Land Classification in Canada, Proceedings of the Second Meeting. Canada Committee on Ecological (Biophysical) Land Classification, (April 78) Victoria, British Columbia. Ecological Land Classification Series #7. 373-384 p.

Ecological land classification project, where a range of environmental parameters rather than single discipline approaches were used, have been undertaken in northern Canada. Although the studies were not coordinated, almost all used the ecoregions and their broad subdivisions, ecodistricts. Mapping criteria included parent materials, relief, vegetation, soils, and drainage. Most projects were intended as baseline studies prior to development. One project, in the Mackenzie Valley, went through the appraisal and final decision process. Ecological land information was used to identify possible impacts along the pipeline route.

04 ZONNEVELD, Isaak Samuel.
1966. Plant Ecology in Integrated Surveys of the Natural Environment. ITC-UNESCO Centre for Integrated Surveys, Delft, Netherlands. ITC Publication S2. 23 p.

Integrating invento